MODEL **GRA-900-6 Remote Control**

HEATHKIT®

ASSEMBLY MANUAL

HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATHKIT

RUSH

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HEATH COMPANY
Benton Harbor, Michigan 49022

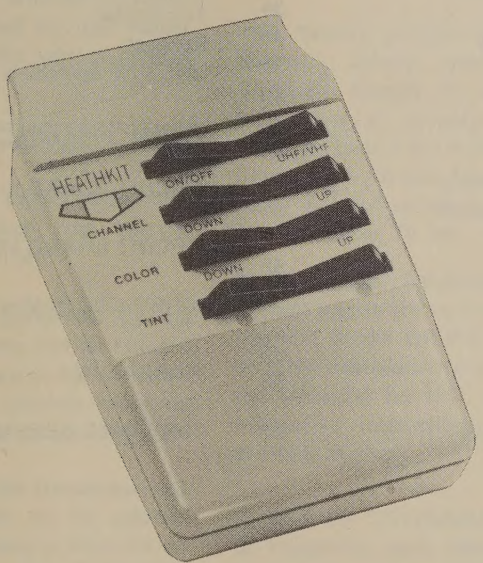
Prices and specifications subject to change without notice.

Assembly and Operation of the

HEATHKIT

REMOTE CONTROL

MODEL GRA-900-6



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heathkit Model GRA-900-6 Remote Control is for use with the Heathkit Model GR-900 Color TV Receiver. The Remote Control consists of the following basic units:

- A hand-held transmitter that will produce ultrasonic signals. These signals are controlled by four rocker switches, which let you select the various control functions of the Receiver.
- A microphone that will pick up these signals.
- A receiver that converts the signals from the microphone into controlling signals that operate control motors and relays in the TV Set.

The following TV functions can be performed by the Remote Control: TV on, reduced volume, further reduced volume, TV off, UHF or VHF selection, up or down channel selection in both UHF and VHF mode, color clockwise and counterclockwise, and tint clockwise and counterclockwise.

No connections are required between the transmitter and the TV Set. The transmitter can operate the TV controls from a distance of at least 20 feet, as long as there are no obstructions between the transmitter and the TV Set. The transmitter circuit is transistorized with all components except the power source, a 9-volt battery, mounted on a printed circuit board. The complete transmitter is enclosed in an attractive, beige plastic case.

The receiver contains one integrated circuit and eight transistor circuits which perform the remote control functions. Except for a stepping relay and the power transformer, all components are mounted on a circuit board. A special feature is a built-in meter for adjustment purposes. This deluxe Remote Control system will provide you with many years of service and easy tuning and control of your Heathkit Color TV Set.

NOTE: Special installation instructions for this Remote Control system are included in the Assembly Manual for the Heathkit Model GR-900 Color TV Set. If you purchased both the television kit and the Remote Control kit, assemble the television kit first. Use the special Remote Control installation instructions contained in the television kit assembly manual.

Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

ASSEMBLY PROCEDURE

NOTE: Before you start to assemble this kit, read the "Kit Builders Guide" for complete information on wiring, soldering, and step-by-step assembly procedures.

The assembly of your Remote Control system is divided into three sections: "Transmitter," "Receiver," and "TV Set Modification." Each section has its own Parts List and Parts Pictorial. There is also a separate package of parts for each section: Pack #1, Pack #2, and Pack #3. CAUTION: Do not open any of the packs until you are instructed to do so at the beginning of a Parts List.

NOTE: Resistors will be identified by the resistance value in ohms, (Ω, kΩ, or MΩ) and color code. Capacitors will be identified by the capacitance value (pF or μF) and type (disc, mica, electrolytic, etc.).

TRANSMITTER

NOTE: One of the following batteries should be purchased at this time for installation in the transmitter after it has been completed.

One 9-volt NEDA type 1604 battery; such as Burgess #2U6, Eveready #216, Mallory #MN1604, RCA #5323, or Ray-O-Vac #1604.

PARTS LIST

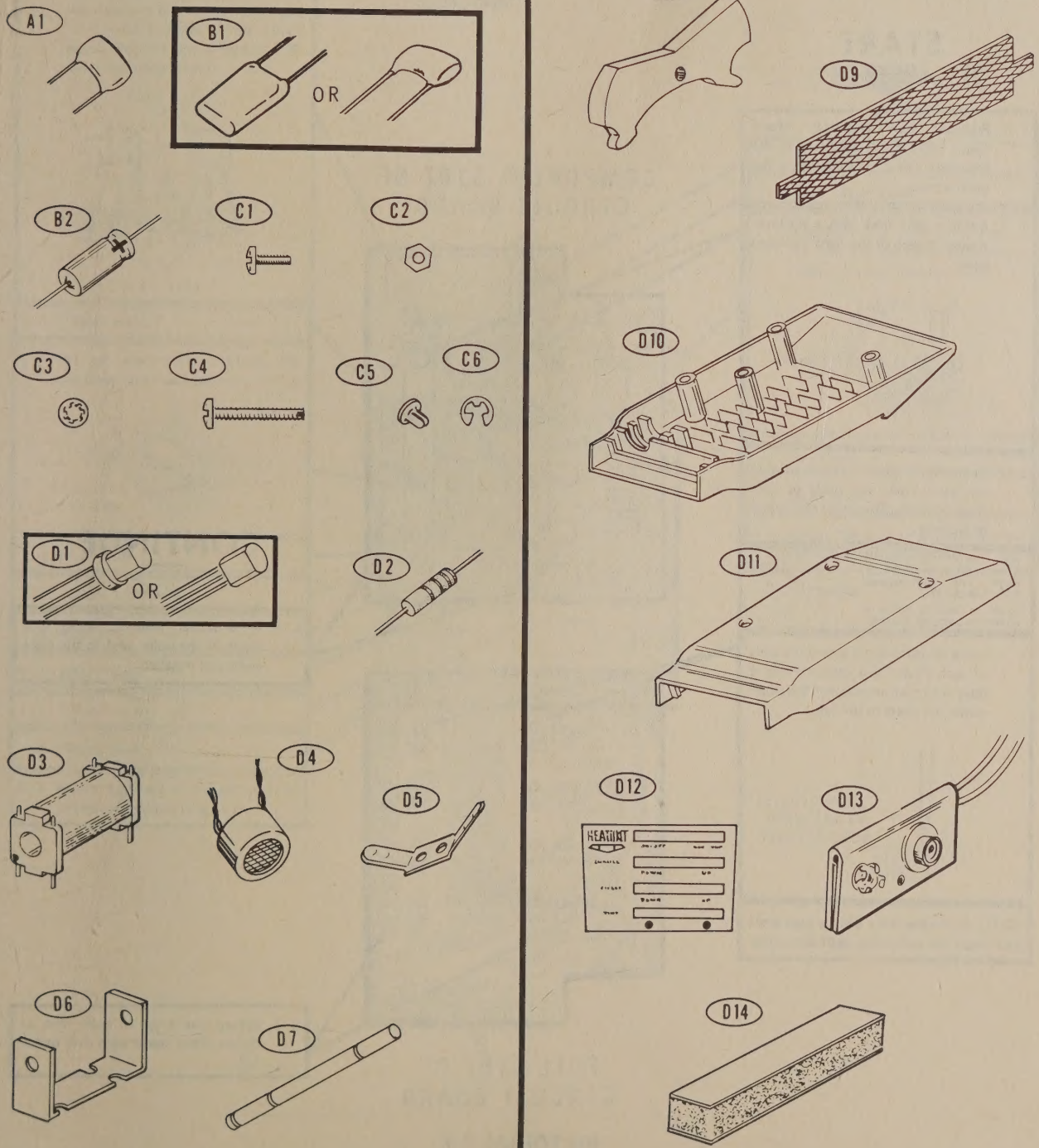
Open Pack #1 and check each part against the following list. The key numbers correspond to the numbers on Parts Pictorial #1.

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
CAPACITORS				
Mica				
A1	20-173	1	20 pF	.20
A1	20-174	1	42 pF	.20
A1	20-175	1	67 pF	.20
A1	20-176	1	94 pF	.20
A1	20-163	1	115 pF	.25
A1	20-177	1	125 pF	.25
A1	20-178	1	160 pF	.25
A1	20-164	1	180 pF	.30
A1	20-165	1	200 pF	.30
Others				
B1	27-47	1	.1 μF Mylar* (50V)	.20
B2	25-54	1	10 μF electrolytic	.20
HARDWARE				
C1	250-49	8	3-48 x 1/4" screw	.05
C2	252-1	8	3-48 nut	.05
C3	254-7	16	#3 lockwasher	.05
C4	250-419	4	4-24 x 5/8" self-tapping screw	.05
C5	256-49	18	Split rivet (2 extra)	.05
C6	253-107	3	E washer	.05

*DuPont Registered Trademark

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
MISCELLANEOUS				
D1	417-118	1	2N3393 transistor	.40
D2	1-73	1	8200 Ω resistor (gray-red-red)	.10
D3	40-848	1	Oscillator coil	1.35
D4	473-5	1	Transducer	2.20
D5	258-95	4	Spring contact	.05
D6	204-866	1	Rocker arm bracket	.10
D7	453-164	1	Rocket arm shaft	.10
D8	266-110	4	Plastic rocker arm	.10
D9	209-52	1	Transmitter grille	.20
	92-616	1	Transmitter case consisting of:	.80
D10		1	Case top	
D11		1	Case bottom	
D12	390-395	1	Transmitter trim panel	1.00
D13	432-33	1	Battery connector	.25
D14	73-64	2	Foam tape	.25
	85-266-2	1	Circuit board	1.15
	490-5	1	Nut starter	.10
	331-8	1	Solder (Additional 3' rolls of solder, #331-6 can be ordered for 15 cents each.)	.40
PARTS FROM FINAL PACK				
	391-34	1	Identification label	
	597-260	1	Parts Order Form	
	597-308	1	Kit Builders Guide Manual (See front cover for part number.)	2.00

PARTS PICTORIAL



STEP-BY-STEP ASSEMBLY

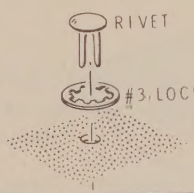
Before starting to assemble this kit, read the "Kit Builders Guide" for complete information on wiring, soldering, and step-by-step assembly procedures.

Resistors will be called out by the resistance value (in Ω or kΩ) and color code. Capacitors will be called out by the capacitance value (in pF or μF) and type (disc, electrolytic, Mylar, etc.).

START

( ) Position the transmitter circuit board (#85-266-2) as shown in the Pictorials. Complete each step in the order listed.

( ) Install a split rivet with a #3 lockwasher in each of the eight indicated holes.

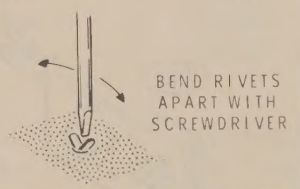


( ) Temporarily place a piece of thin cardboard, over the rivets to hold them in place. Then turn the circuit board over.

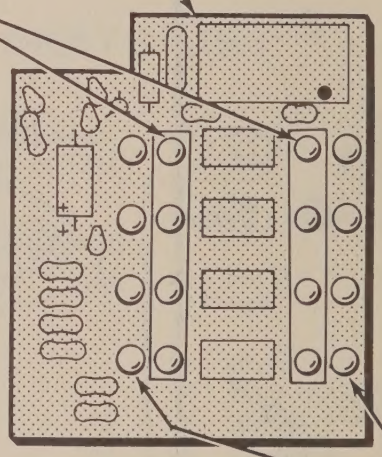
FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN...

WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

( ) Use a screwdriver to spread the ends of each rivet. Turn each rivet so it does not touch an adjacent foil; then solder the rivets to the foil.

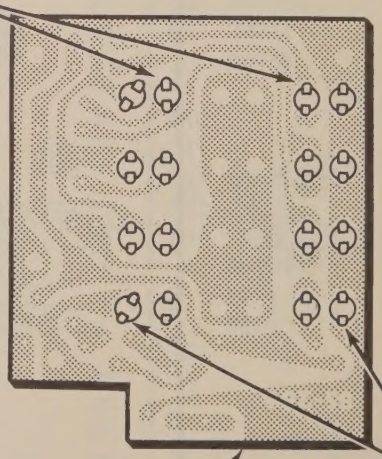


NOTE: No lockwashers will be used when you install the remaining eight split rivets.



CONTINUE

( ) In a similar manner, install split rivets in the holes next to the eight rivets just installed.

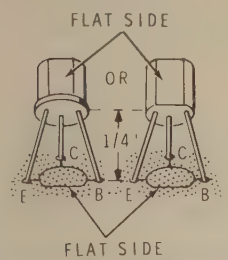


( ) Spread the ends of each rivet as before. Then solder each rivet to the foil.

PICTORIAL 1-1

START

( ) 2N3393 transistor (#417-118) at Q8. Insert the E, C, and B leads of the transistor into the corresponding E, C, and B holes in the circuit board. Position the transistor 1/4" above the circuit board.



( ) 115 pF mica.

( ) 10 µF electrolytic. Position the positive (+) end as shown.

( ) 67 pF mica.

( ) 180 pF mica.

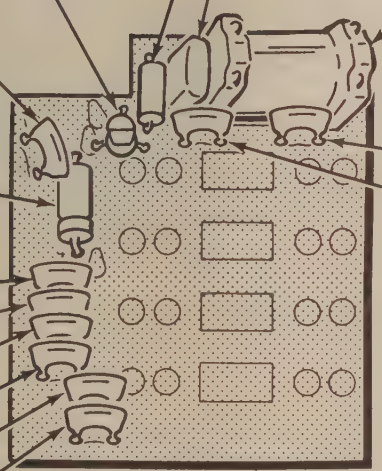
( ) 42 pF mica.

( ) 200 pF mica.

( ) 125 pF mica.

( ) 160 pF mica.

( ) Solder the leads to the foil and cut off the excess lead lengths.

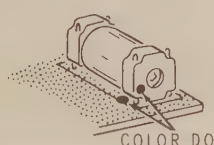


CONTINUE

( ) 8200 Ω (gray-red-red).

( ) .1 µF Mylar (50V).

( ) Oscillator coil (#40-848). Position the end with the color dot as shown. Solder the four leads to the foil.



( ) 94 pF mica.

( ) 20 pF mica.

( ) Solder the leads to the foils and cut off the excess lead lengths.

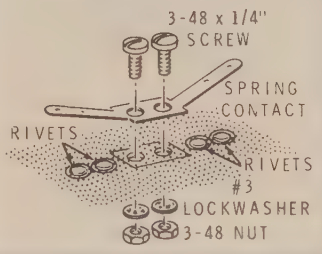
PICTORIAL 1-2

START

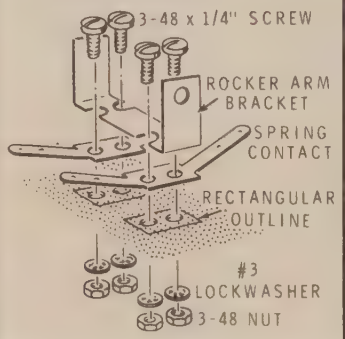
Position the transmitter circuit board as shown. Note that it is rotated one half turn from its previous position.

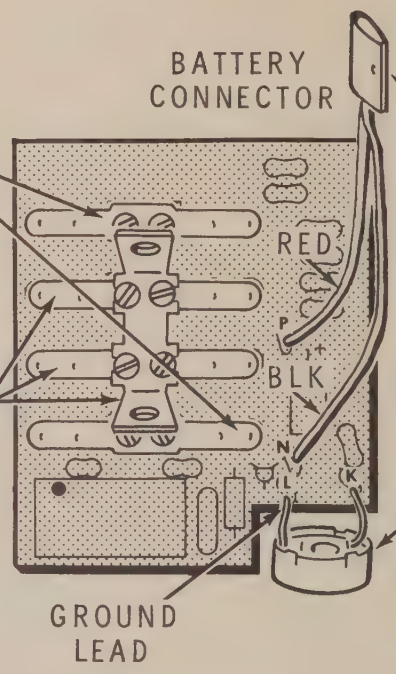
NOTE: Use the plastic nut starter to hold and start 3-48 and 6-32 nuts on screws.

( ) Mount two spring contacts with 3-48 x 1/4" screws, #3 lockwashers, and 3-48 nuts as shown. Before tightening the screws, make sure the contact is directly over the rivets. The contact must touch both rivets when it is pushed down.



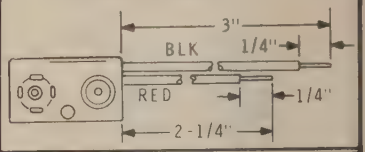
( ) Mount two spring contacts and the rocker arm bracket with 3-48 x 1/4" screws, #3 lockwashers, and 3-48 nuts. Center the spring contacts in the rectangular outlines on the circuit board. Make sure the rocker arm bracket is centered over both rectangular outlines.





CONTINUE

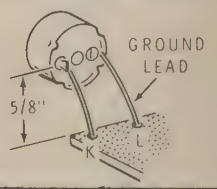
( ) Prepare the leads of the battery connector as shown.



( ) Insert the red lead into hole P and the black lead into hole N.

( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) Transducer #473-5. (NOTE: One lead is connected to the metal case.) Insert this ground lead into hole L and the other lead into hole K.

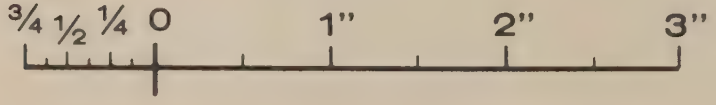


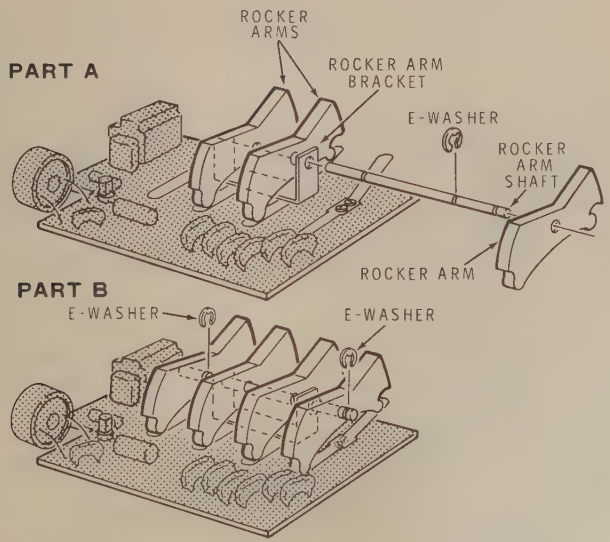
( ) Position the transducer 5/8" from the circuit board. Then solder the leads to the foils and cut off the excess lead lengths.

( ) Carefully inspect the foil side on the circuit board and solder any connections that might have been missed. Also inspect the circuit board to be sure there are no solder bridges between foils.

FINISH

PICTORIAL 1-3





PICTORIAL 1-4

Refer to Pictorial 1-4 for the following steps.

( ) Locate the four plastic rocker arms, three E washers, and the rocker arm shaft.

( ) Refer to Part A of Pictorial 1-4 and install an E washer in the indicated groove of the rocker arm shaft. Push on the washer until it snaps in place in the groove.

( ) Start the shaft into the hole in the rocker arm bracket. Place two rocker arms inside the bracket; then slide the shaft through the rocker arms and through the other hole in the bracket.

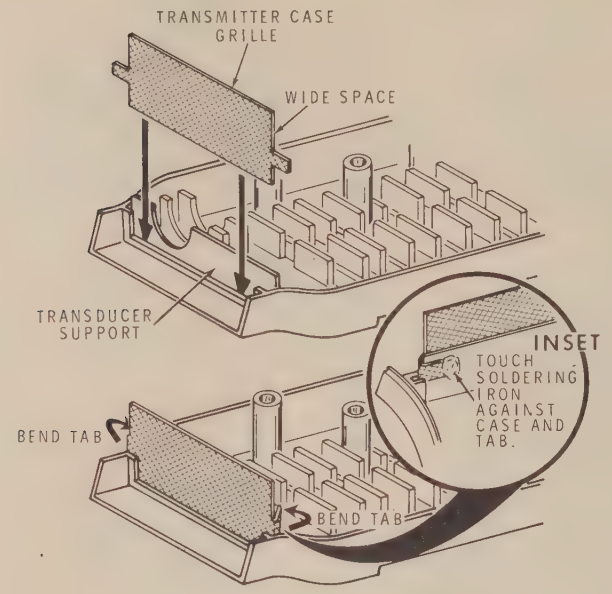
( ) Refer to Part B of Pictorial 1-4 and place another rocker arm at the far end of the bracket. Push the shaft through the rocker arm until the E washer previously installed on the shaft is against the bracket.

( ) Install another E washer in the groove between the rocker arm just installed and the bracket.

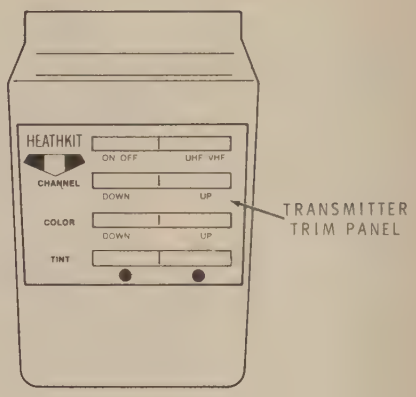
( ) Install the remaining rocker arm on the shaft at the near end of the bracket as shown in Part B of the Pictorial. Then install another E washer in the remaining groove.

( ) Press down on the spring contacts and carefully position each rocker arm over its respective contact.

( ) Press each side of each rocker arm while you observe the spring contacts. The dimples on each spring should make contact with the corresponding rivets on the circuit board.



Detail 1-5A



PICTORIAL 1-5

Refer to Detail 1-5A for the following steps.

( ) Position the top of the transmitter case as shown.

( ) Position the transmitter case grille so the wide space at each end is up as shown. Then insert the grille into the slot in the front of the case as indicated by the arrows.

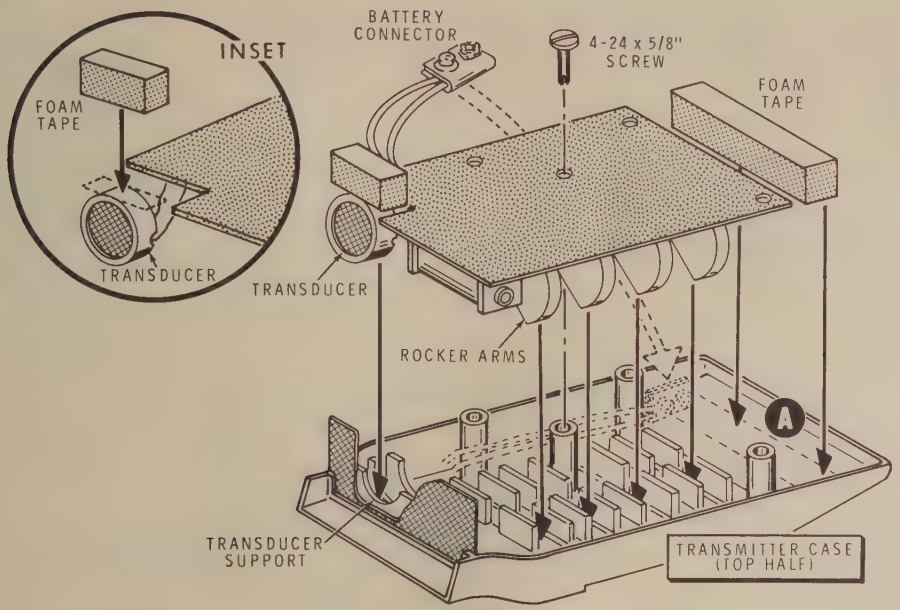
( ) Bend the grille tabs around the flat against the inside of the support.

( ) Touch the grille tabs slightly with a hot soldering iron as shown in the inset drawing. This will anchor the grille to the support.

( ) Peel off the backing paper from the transmitter trim panel. Then refer to Pictorial 1-5 and install the trim panel on the front of the case. Carefully center the trim panel over the slots and press it in place on the case.

NOTE: There is a transparent plastic coating on the front of the transmitter trim panel to protect the lettering. Be careful when you perform the next step so you do not scratch the trim panel.

( ) Carefully peel the plastic protective coating from the lettered side of the transmitter trim panel. Then wipe the panel with a soft clean cloth.



PICTORIAL 1-6

Refer to Pictorial 1-6 for the following steps.

( ) Place the transmitter circuit board in the case with the transducer resting on the transducer support and the rocker arms protruding through their respective slots.

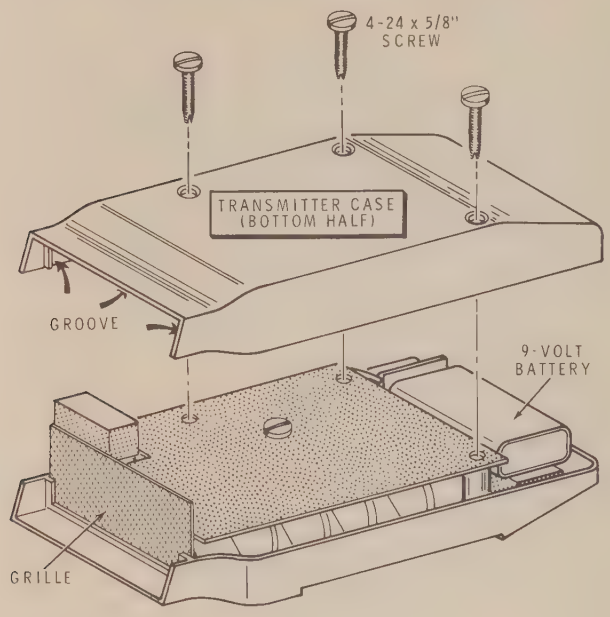
( ) Be sure the leads of the battery connector are positioned inside the circuit board supports as indicated by the dotted lines and arrow. Secure the circuit board to the case with a 4-24 x 5/8" screw through the hole in the center of the circuit board.

( ) Use a small screwdriver and carefully position the transducer so it is against the front of the case. Be sure the transducer lead connected in hole K (at the corner of the circuit board) does not touch the metal shell of the transducer.

( ) Peel the backing paper from only one side of one of the lengths of sticky-back foam tape. Install the tape on the inside of the case at location A, as shown in the Pictorial.

( ) Cut the remaining length of foam tape into two 1-inch lengths.

( ) Remove the backing paper from only one side of one of the lengths. Then refer to the inset drawing on Pictorial 1-6 and press the tape onto the transducer as shown.

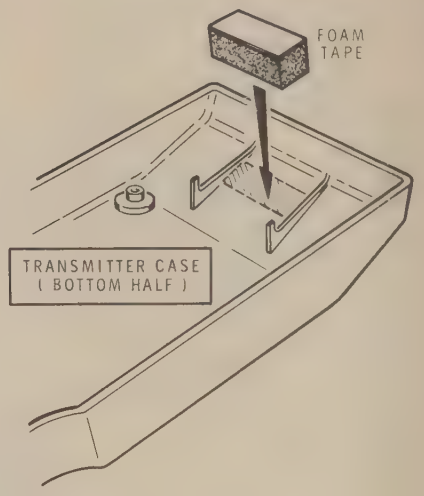


PICTORIAL 1-7

Refer to Pictorial 1-7 for the following steps.

NOTE: The 9-volt battery (NEDA 1604) used in the next step is not supplied with the kit and must be purchased locally.

( ) Snap the battery connector on the 9-volt battery and place the battery on the foam tape.



Detail 1-7A

( ) Peel the backing paper from only one side of the remaining length of foam tape. Install the tape on the inside of the bottom half of the transmitter case as shown in Detail 1-7A.

( ) Place the bottom half of the case on the top half as shown in the Pictorial. Be sure the grille is in the groove in the case. Secure the bottom to the top of the case with three 4-24 x 5/8" screws.

This completes the assembly of the Transmitter. Set it aside until it is called for during the "Initial Checkout" section of this Manual.

RECEIVER

PARTS LIST

Open Pack #2 and check each part against the following list. The key numbers correspond to the numbers on the Receiver Parts Pictorial (fold-out from Page 17).

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
RESISTORS				
1/2-Watt				
A1	1-103	1	33 Ω (orange-orange-black)	.10
A1	1-83	2	56 Ω (green-blue-black-gold)	.10
A1	1-151	8	330 Ω (orange-orange-brown-gold)	.10
A1	1-9	1	1000 Ω (brown-black-red)	.10
A1	1-44	1	2200 Ω (red-red-red)	.10
A1	1-16	2	4700 Ω (yellow-violet-red)	.10
A1	1-105	9	10 kΩ (brown-black-orange-gold)	.10
A1	1-24	1	33 kΩ (orange-orange-orange)	.10
A1	1-26	1	100 kΩ (brown-black-yellow)	.10
A1	1-27	1	150 kΩ (brown-green-yellow)	.10
A1	1-86	1	5.6 MΩ (green-blue-green)	.10
2-Watt				
A2	1-37-2	1	3.3 Ω (orange-orange-gold)	.35
A2	1-20-2	1	100 Ω (brown-black-brown)	.15
NOTE: The following 2-watt wire-wound resistor is physically smaller than the other 2-watt resistors.				
A3	3-7-2	1	1 Ω (brown-black-gold)	.10
CAPACITORS				
Disc				
B1	21-7	1	33 pF	.10
B1	21-36	1	.002 μF	.10
B1	21-27	1	.005 μF	.10
B1	21-16	1	.01 μF	.10
B1	21-70	5	.01 μF 1.4 kV	.15
Mylar				
B2	27-63	2	.022 μF	.10
B2	27-73	1	.047 μF	.15
B2	27-28	1	.1 μF 400V	.20
B3	27-80	2	.33 μF	.40

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
Electrolytic-Mica				
B4	25-145	8	25 μF electrolytic	.50
B5	25-116	1	50 μF electrolytic (vertical mount)	.50
B4	25-146	1	100 μF electrolytic	.45
B6	20-107	8	680 pF mica	.40
DIODES-TRANSISTORS-IC				
C1	57-27	3	1N2071 silicon diode	.50
C1	56-45	1	VR-20 zener diode	1.00
C2	417-118	8	2N3393 transistor	.40
C3	442-4	1	CA3035V1 integrated circuit	3.90
RELAYS-COILS-TRANSFORMERS				
D1	69-50	8	Relay	2.70
D2	69-60	1	Stepping relay	5.30
D3	40-842	2	Coil	.75
D3	40-843	2	Coil	.75
D3	40-844	4	Coil	.75
D4	40-849	1	Driver transformer	.90
	54-293	1	Power transformer	3.45
HARDWARE				
E1	250-56	10	6-32 x 1/4" screw (1 extra)	.05
E2	250-89	3	6-32 x 3/8" screw (1 extra)	.05
E3	252-3	12	6-32 nut (1 extra)	.05
E4	254-1	12	#6 lockwasher	.05
E5	250-365	6	#6 x 1/4" sheet metal screw	.05
E6	250-8	1	#6 x 3/8" sheet metal screw	.05
E7	250-252	4	#6 x 5/8" bronze screw	.05
E8	250-137	1	8-32 x 3/8" screw	.05
E9	254-2	1	#8 lockwasher	.05

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
METAL PARTS				
F1	200-618	2	Chassis-half	.65
F2	206-390	1	Shield, top	.30
F3	206-391	1	Shield, bottom	.30
WIRE-SLEEVING-CABLE ASSEMBLY				
	344-15	1	Black stranded wire	.05/ft
	344-29	1	Blue stranded wire	.05/ft
	344-32	1	Green stranded wire	.05/ft
	344-79	1	Brown stranded wire	.05/ft
	344-50	1	Black solid wire	.05/ft
	344-51	1	Brown solid wire	.05/ft
	344-52	1	Red solid wire	.05/ft
	344-54	1	Yellow solid wire	.05/ft
	346-7	1	Clear sleeving	.05/ft
	134-272	1	15-wire connector assembly	1.35
MISCELLANEOUS				
G1	73-1	1	3/8" grommet	.10
G1	73-3	1	1/2" grommet	.10
G2	263-7	1	Felt pad	.05
G3	431-14	1	2-lug terminal strip	.10
G4	432-66	1	Terminal connector	.10
G5	434-42	1	Phono socket	.10
G6	473-4	1	Microphone	3.60
	85-569-2	1	Circuit board	2.50
	407-116	1	Meter	3.00
	490-1	1	Plastic alignment tool	.10

NOTE: See Page 67 "Replacement Parts and Price Information."

STEP-BY-STEP ASSEMBLY

START

( ) Position the receiver circuit board (#85-569-2) as shown.

( ) 33 Ω (orange-orange-black).

( ) 100 Ω, 2-watt (brown-black-brown).

( ) 330 Ω (orange-orange-brown-gold).

( ) 10 kΩ (brown-black-orange-gold).

( ) 330 Ω (orange-orange-brown-gold).

( ) 10 kΩ (brown-black-orange-gold).

( ) 330 Ω (orange-orange-brown-gold).

( ) 10 kΩ (brown-black-orange-gold).

( ) 330 Ω (orange-orange-brown-gold).

( ) 10 kΩ (brown-black-orange-gold).

( ) 330 Ω (orange-orange-brown-gold).

( ) 10 kΩ (brown-black-orange-gold).

( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) 330 Ω (orange-orange-brown-gold).

( ) 56 Ω (green-blue-black-gold).

( ) 10 kΩ (brown-black-orange-gold).

( ) 330 Ω (orange-orange-brown-gold).

( ) 10 kΩ (brown-black-orange-gold).

( ) 330 Ω (orange-orange-brown-gold).

( ) 10 kΩ (brown-black-orange-gold).

( ) 56 Ω (green-blue-black-gold).

( ) 4700 Ω (yellow-violet-red).

( ) 2200 Ω (red-red-red).

( ) Solder the leads to the foil and cut off the excess lead lengths.

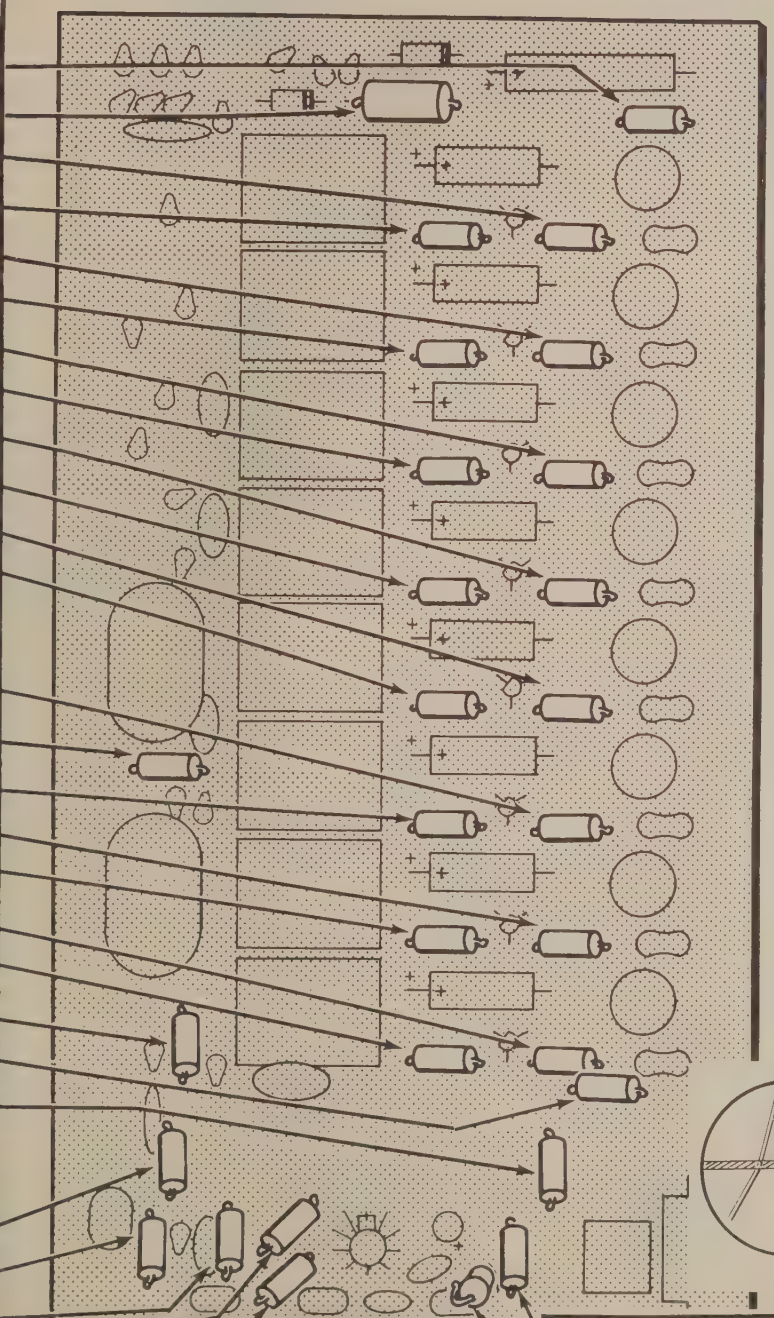
( ) 5.6 MΩ (green-blue-green).

( ) 100 kΩ (brown-black-yellow).

( ) 33 kΩ (orange-orange-orange).

( ) 1000 Ω (brown-black-red).

( ) 150 kΩ (brown-green-yellow).

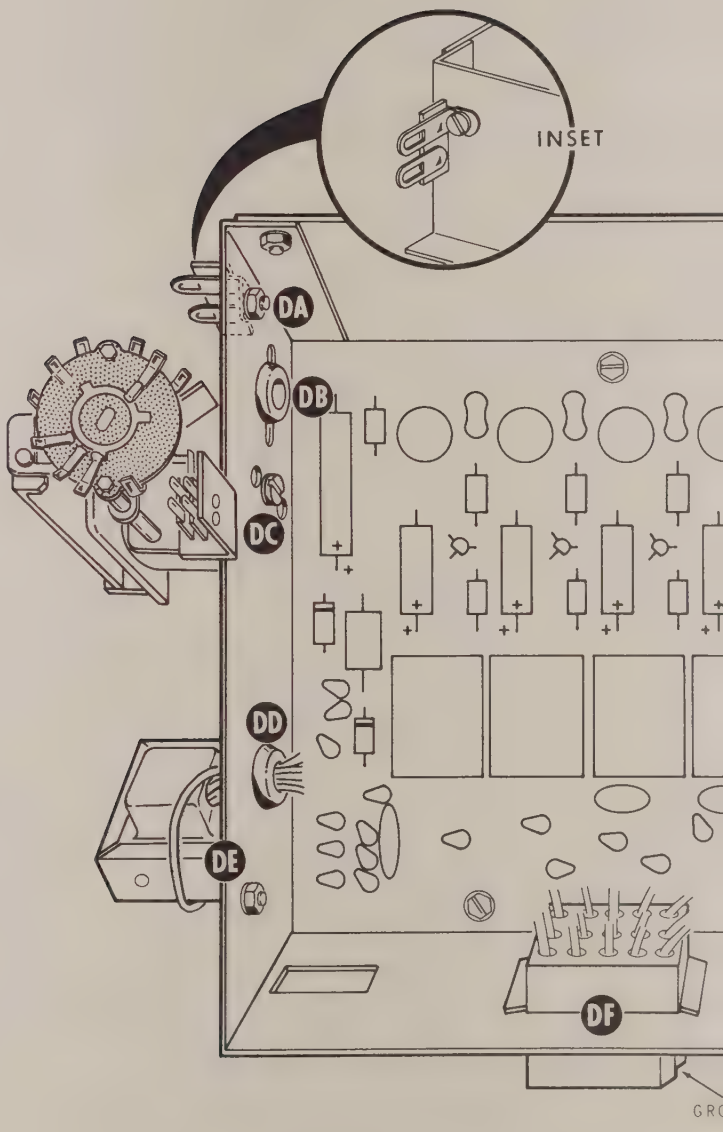


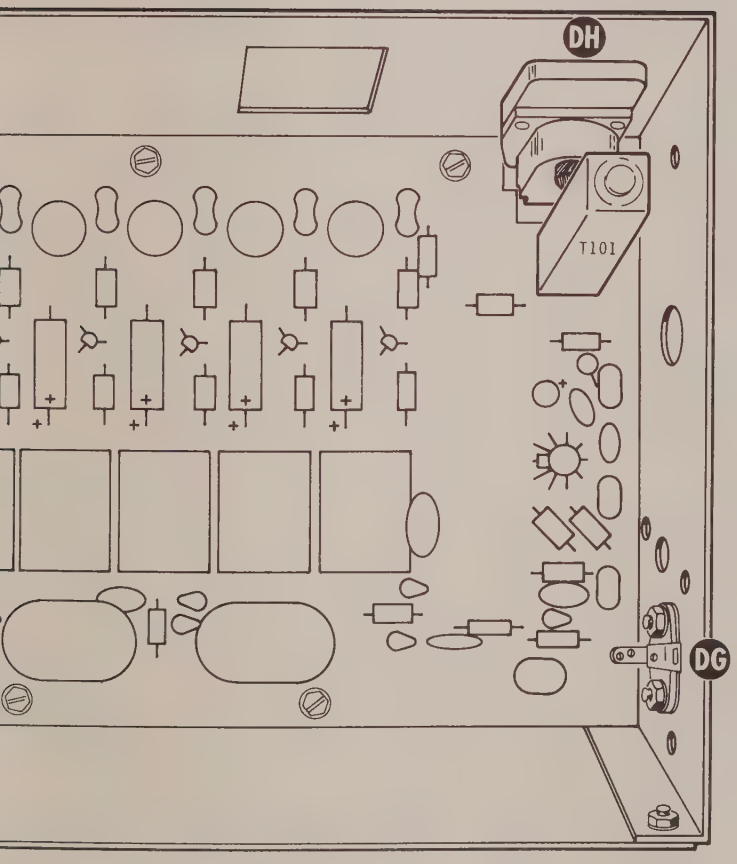
( ) 4700 Ω (yellow-violet-red).

( ) 10 kΩ (brown-black-orange-gold). Mount this resistor as shown in the inset drawing above.

( ) Solder the leads to the foil and cut off the excess lead lengths.

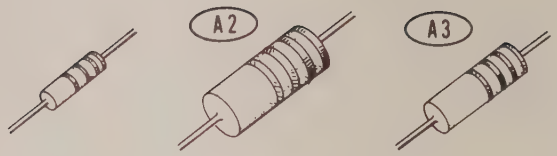
PICTORIAL 2-1

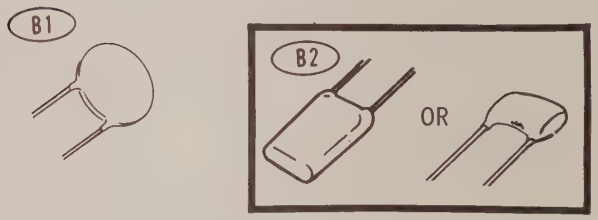

INSET
DA
DB
DC
DD
DE
DF

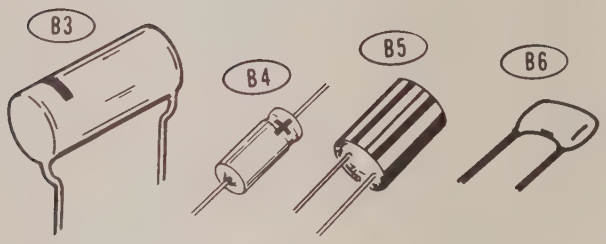


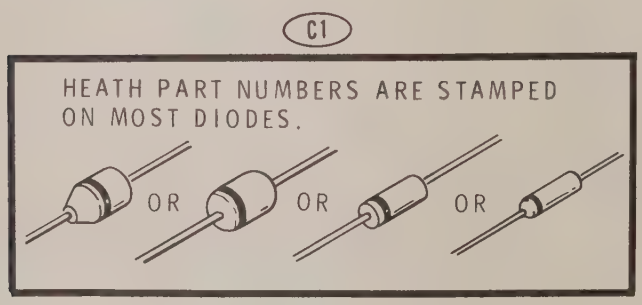
END

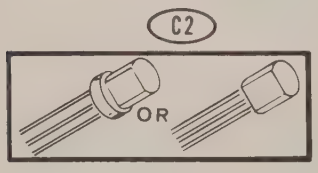
TORIAL 3-1

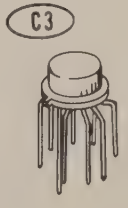


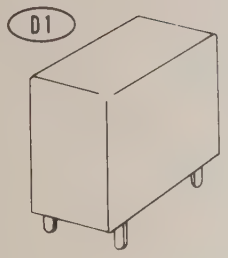

B2
OR

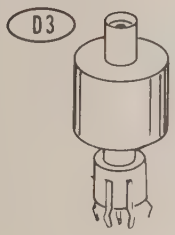


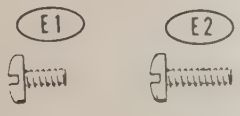

HEATH PART NUMBERS ARE STAMPED
ON MOST DIODES.
OR
OR
OR

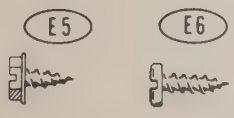

OR



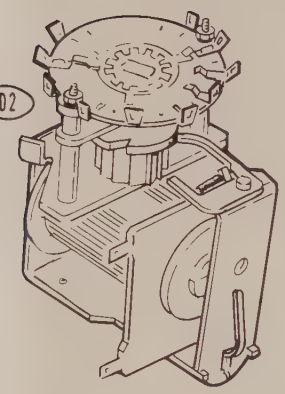


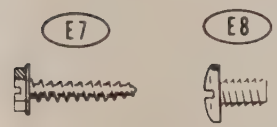


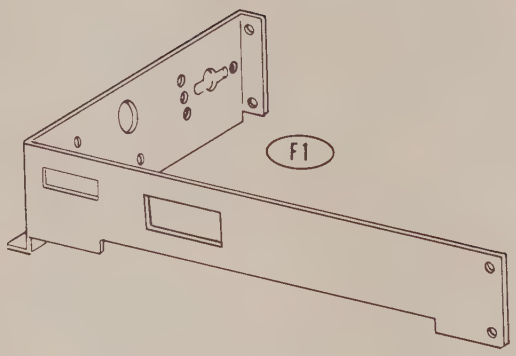


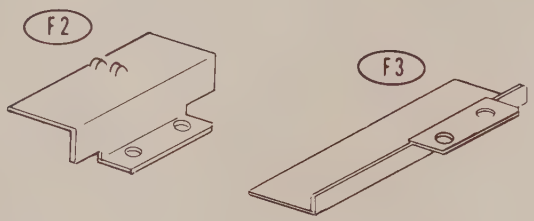


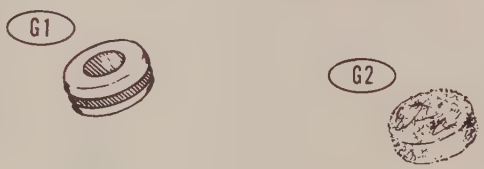
PARTS PICTORIAL

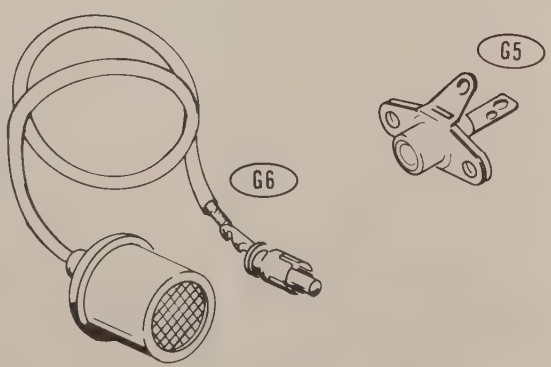






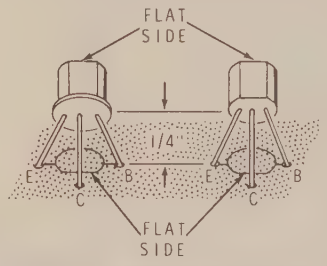






START

NOTE: When you install each of the following transistors (#417-118), line up the flat on the transistor with the outline of the flat on the circuit board. Then insert the E, C, and B leads of the transistor into the corresponding E, C, and B holes in the circuit board. Position the transistor 1/4" above the circuit board.



( ) 2N3393 transistor at Q102

( ) 2N3393 transistor at Q103

( ) 2N3393 transistor at Q104

( ) 2N3393 transistor at Q105

( ) 2N3393 transistor at Q106.

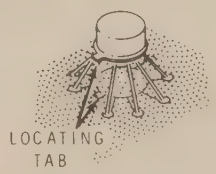
( ) 2N3393 transistor at Q107.

( ) 2N3393 transistor at Q108

( ) 2N3393 transistor at Q109

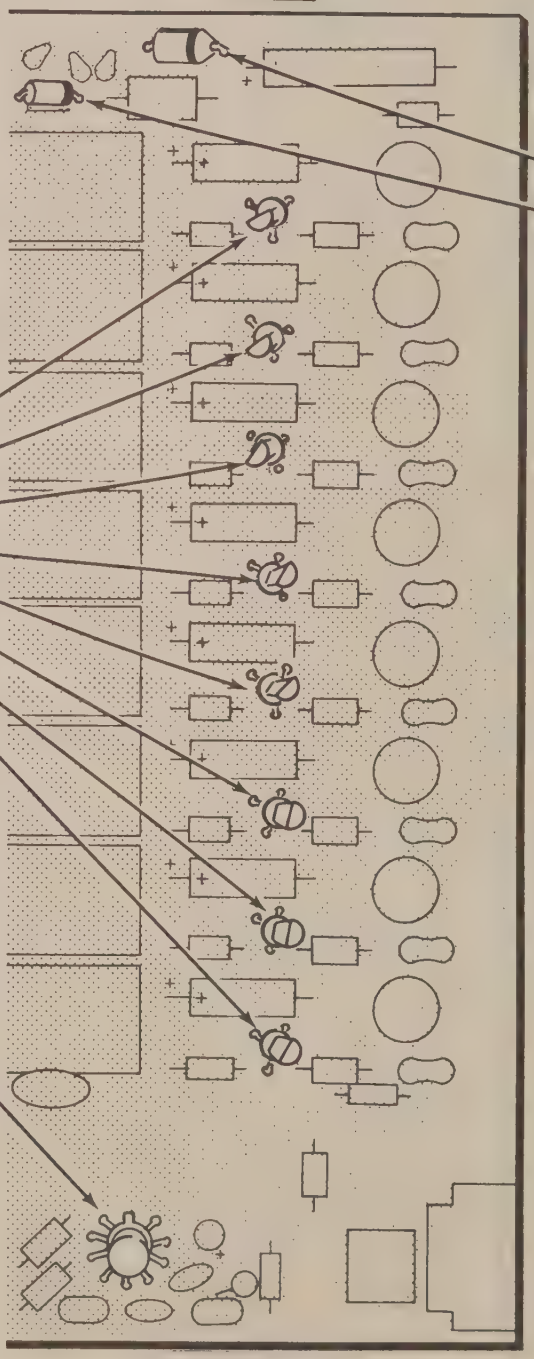
NOTE: Do not straighten the leads when you install the integrated circuit as they are preformed to match the mounting holes in the circuit board.

( ) Integrated circuit (#442-4) at Q101. Line up the locating tab of the integrated circuit with the outline of the locating tab on the circuit board. Then insert the leads into their respective holes, 1 through 10.



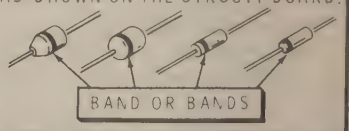
( ) Solder the leads to the foil and cut off the excess lead lengths.

SOLDERING IRON TIP



CONTINUE

NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.



( ) Silicon diode (#57-27) at D102.

( ) Zener diode (#56-45) at D101.

( ) Solder the leads to the foil and cut off the excess lead lengths.

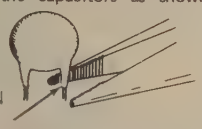
PICTORIAL 2-2

START

FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN...

WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

NOTE: Before installing disc capacitors, remove any insulation on the leads near the body of the capacitors as shown below.



( ) .01 μF disc 1.4 kV.

( ) 680 pF mica.

( ) .01 μF disc 1.4 kV.

( ) 680 pF mica.

( ) .01 μF disc 1.4 kV.

( ) 680 pF mica.

( ) 680 pF mica.

( ) 680 pF mica.

( ) .01 μF disc 1.4 kV.

( ) 680 pF mica.

( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) 680 pF mica.

( ) 680 pF mica.

( ) .01 μF disc 1.4 kV.

( ) .01 μF disc.

( ) 33 pF disc.

( ) .002 μF disc.

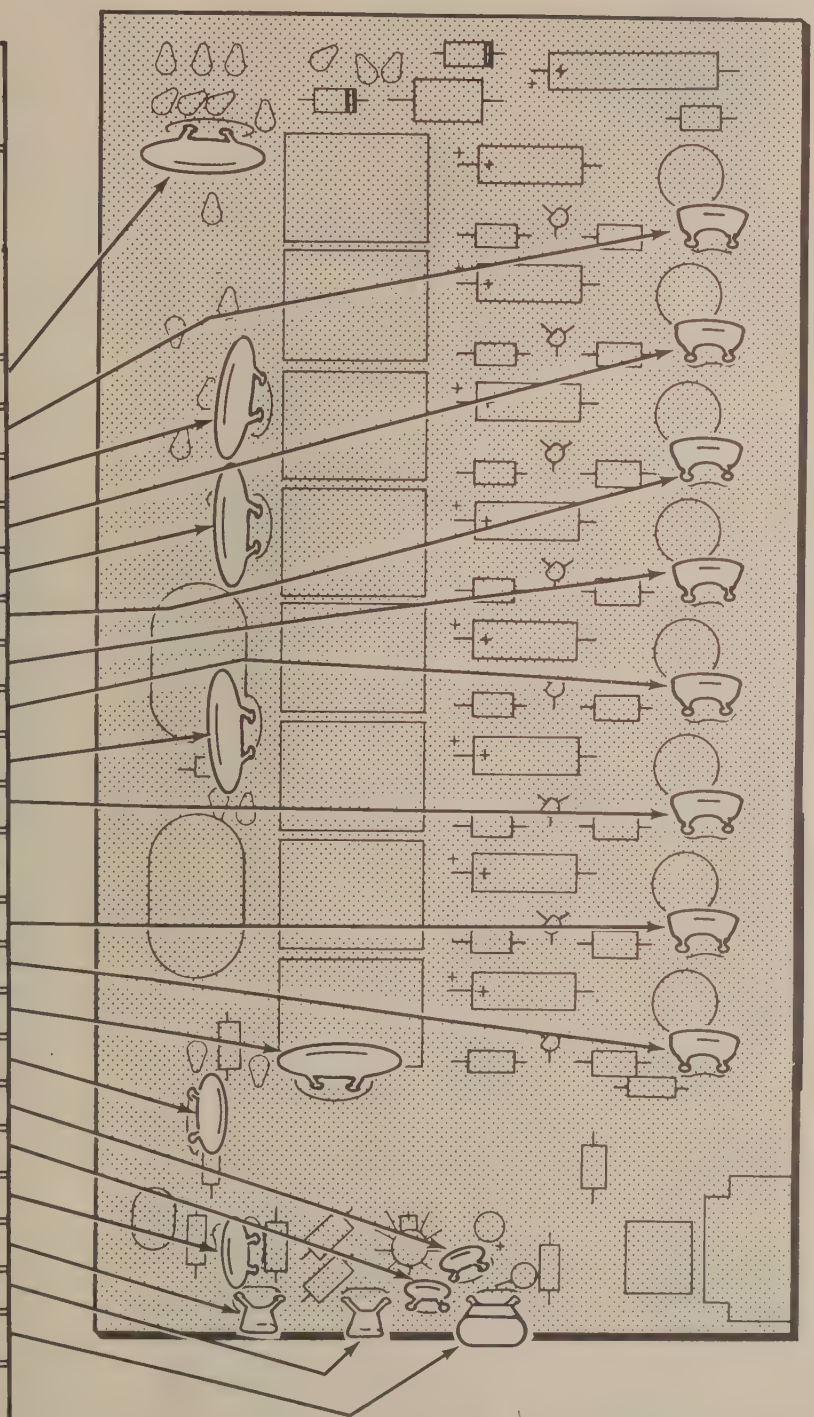
( ) .005 μF disc.

( ) .022 μF Mylar.

( ) .022 μF Mylar.

( ) .047 μF Mylar.

( ) Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 2-3

START

NOTE: When you install electrolytic capacitors, be sure you insert the positive (+) lead in the positive (+) marked hole in the circuit board.

( ) 100 μF electrolytic.

( ) 25 μF electrolytic.

( ) 25 μF electrolytic.

( ) 25 μF electrolytic.

( ) 25 μF electrolytic.

( ) Solder the leads to the foil and cut off the excess lead lengths.

NOTE: Disregard the marking at one end of Mylar capacitors as they may be installed either way.

( ) .33 μF Mylar.

( ) 25 μF electrolytic.

( ) 25 μF electrolytic.

( ) .33 μF Mylar.

( ) 25 μF electrolytic.

( ) 25 μF electrolytic.

( ) .1 μF Mylar.

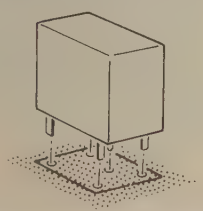
( ) 50 μF vertical mounting electrolytic. Mount this type of capacitor as shown.

( ) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 2-4

START

NOTE: To install a relay, insert its lugs in the matching holes in the circuit board. Hold the relay firmly against the circuit board and solder the lugs to the foils. There is no foil around one lug of each relay; do not apply any solder to this lug. Also, do not cut off any of the excess lug lengths.



( ) Relay (#69-50) at RL101.

( ) Relay (#69-50) at RL102.

( ) Relay (#69-50) at RL103.

( ) Relay (#69-50) at RL104.

( ) Relay (#69-50) at RL105.

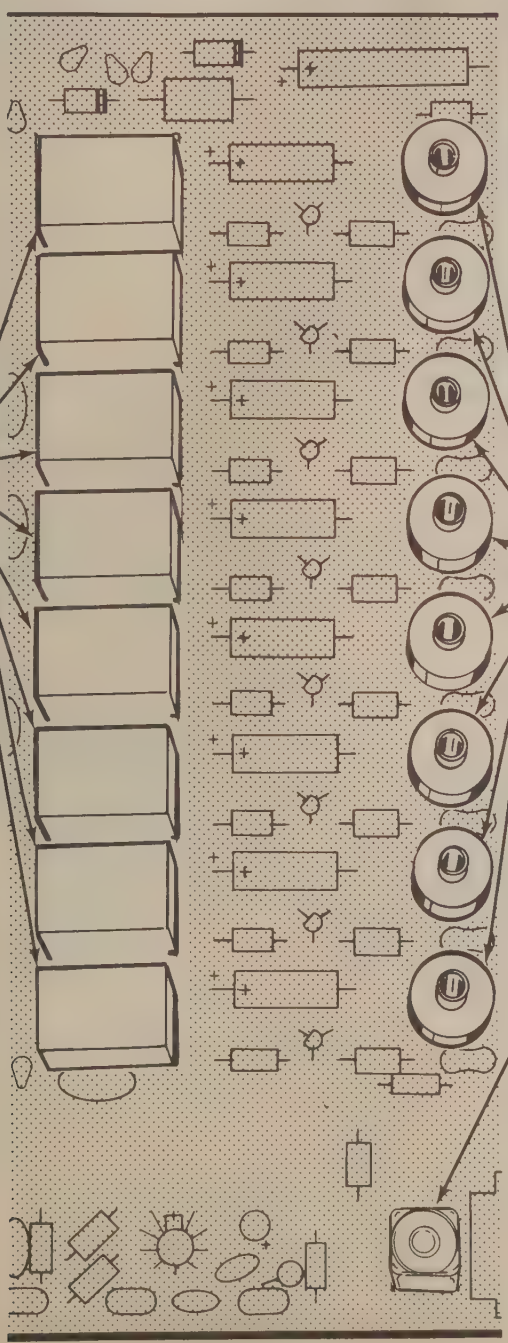
( ) Relay (#69-50) at RL106.

( ) Relay (#69-50) at RL107.

( ) Relay (#69-50) at RL108.

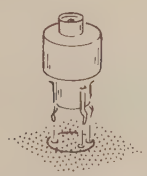
FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN...

WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.



CONTINUE

NOTE: To install a coil, first line up its lugs with the matching holes in the circuit board. Press down on the coil until it snaps into place; then solder the lugs to the foil. Do not cut off the excess lug lengths. Handle the coils carefully to avoid breaking the fine wires connected to the lugs.



( ) Coil (#40-842) at L101.

( ) Coil (#40-843) at L102.

( ) Coil (#40-842) at L103.

( ) Coil (#40-843) at L104.

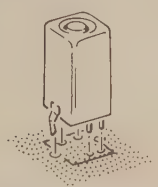
( ) Coil (#40-844) at L105.

( ) Coil (#40-844) at L106.

( ) Coil (#40-844) at L107.

( ) Coil (#40-844) at L108.

( ) Driver Transformer (#40-849) at T101. Line up the lugs with the matching holes in the circuit board. Then push the coil in place and solder each lug to the foil.



( ) Carefully inspect the foil side of the circuit board and solder any connections that might have been missed. Then set the circuit board aside temporarily.

FINISH

PICTORIAL 2-5

CHASSIS

Refer to Pictorial 3-1 (fold-out from Page 18) for the following steps.

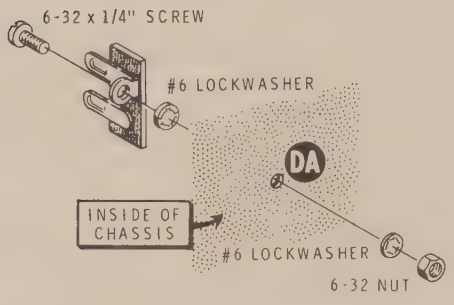
Select either one of the two (identical) chassis halves. Then mount the parts on it as directed in the following steps. These parts will be on the left and front half of the completely assembled chassis.

( ) Install a 3/8" rubber grommet in hole DB.

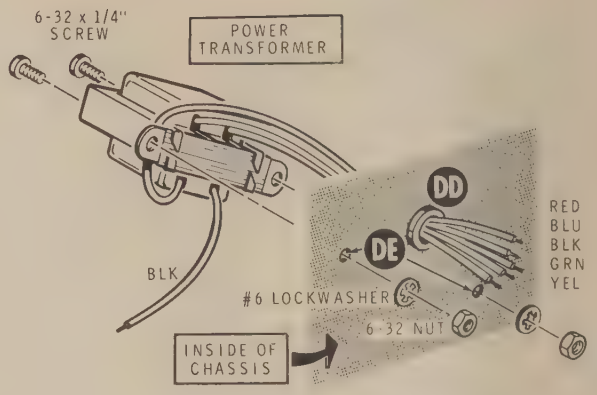
( ) Install a 1/2" rubber grommet in hole DD.

NOTE: When hardware is called for in a step, only the screw size will be given. For instance, if "6-32 x 1/4" hardware" is called for, it means that a 6-32 x 1/4" screw, one or more #6 lockwashers, and a 6-32 nut should be used. The Detail referred to in the step will show the proper number of lockwashers to use.

( ) Refer to Detail 3-1A and mount a 2-lug terminal strip at DA with 6-32 x 1/4" hardware. Position the terminal strip as shown in the Pictorial.



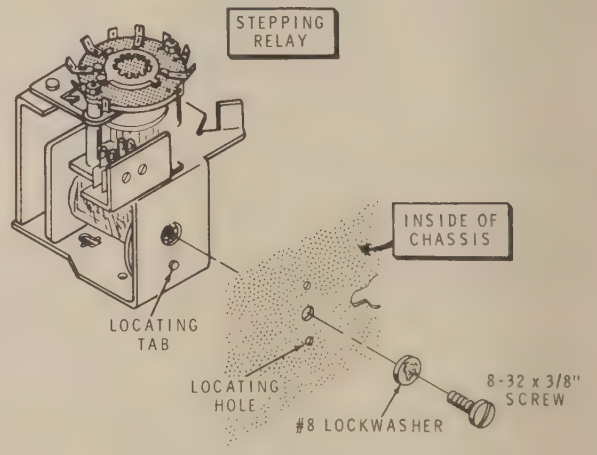
Detail 3-1A



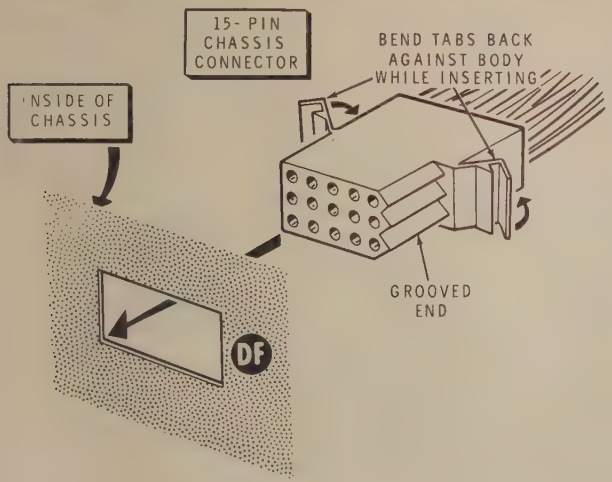
Detail 3-1B

( ) Refer to Detail 3-1B and mount the power transformer at DE with 6-32 x 1/4" hardware. Insert all of the leads except the indicated black lead through grommet DD.

( ) Refer to Detail 3-1C and mount the stepping relay at DC. Be sure the locating tab on the relay is in the corresponding locating hole in the chassis. Then secure the relay with an 8-32 x 3/8" screw and a #8 lockwasher.



Detail 3-1C



Detail 3-1D

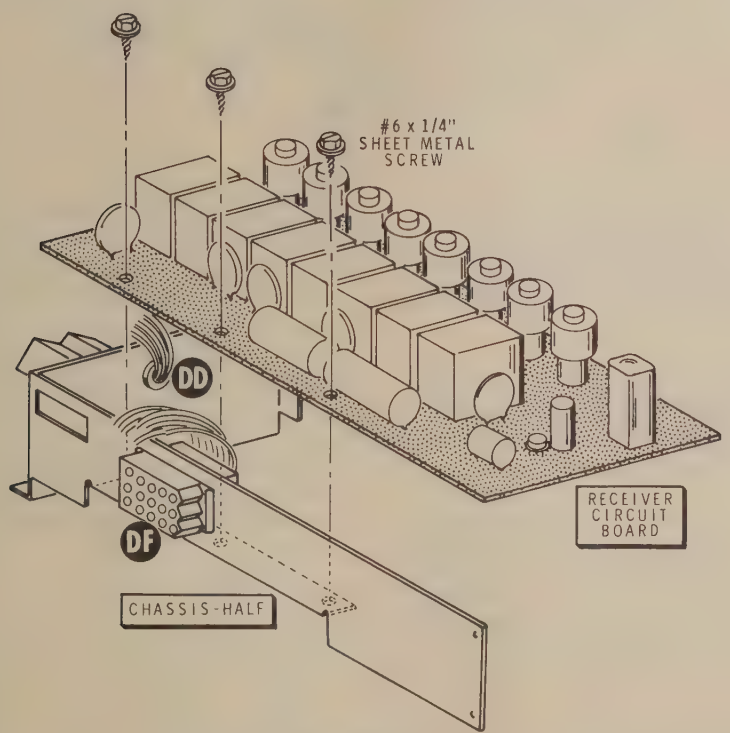
( ) Refer to Detail 3-1D and install 15-wire connector assembly (from the inside of the chassis) in hole DF. Position the grooved end of the connector toward the right end of the chassis-half. Bend back both plastic tabs; then press the connector in until it snaps into place in the chassis.

Refer to Detail 3-1E for the following steps.

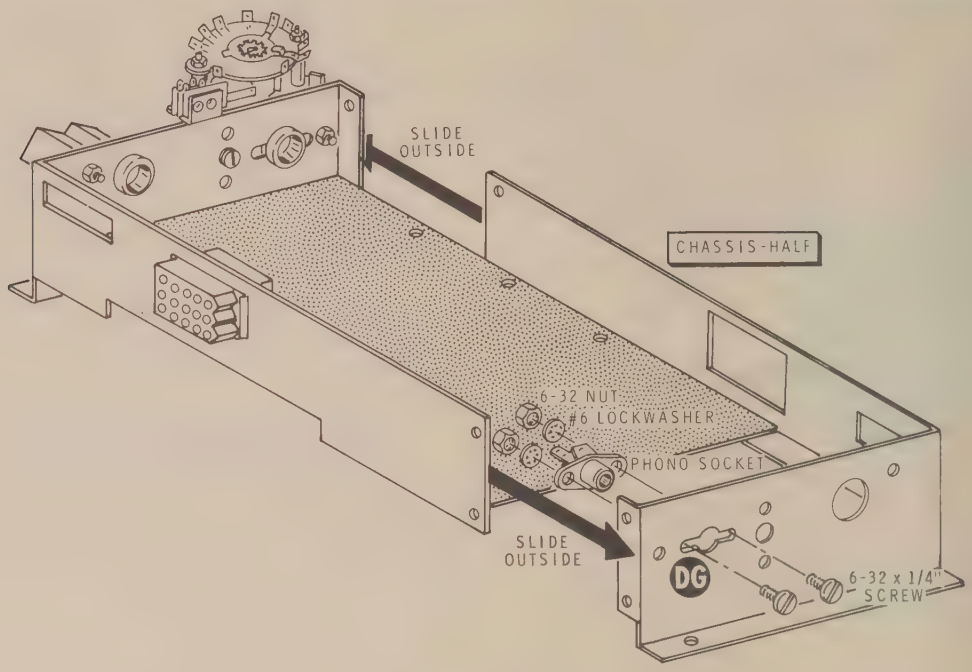
( ) Bend the wires coming from connector DF and grommet DD back out of the way over the chassis while you perform the next step.

( ) Position the receiver circuit board on the mounting flange inside the chassis-half. Secure the circuit board to the flange with three #6 x 1/4" sheet metal screws.

( ) Carefully move the chassis-half and circuit board assembly temporarily aside while you prepare the remaining chassis-half.



Detail 3-1E



Detail 3-1F

Refer to Detail 3-1F for the following steps.

( ) Mount a phono socket on the remaining chassis-half at DG with 6-32 x 1/4" hardware. Position the socket with the lugs as shown.

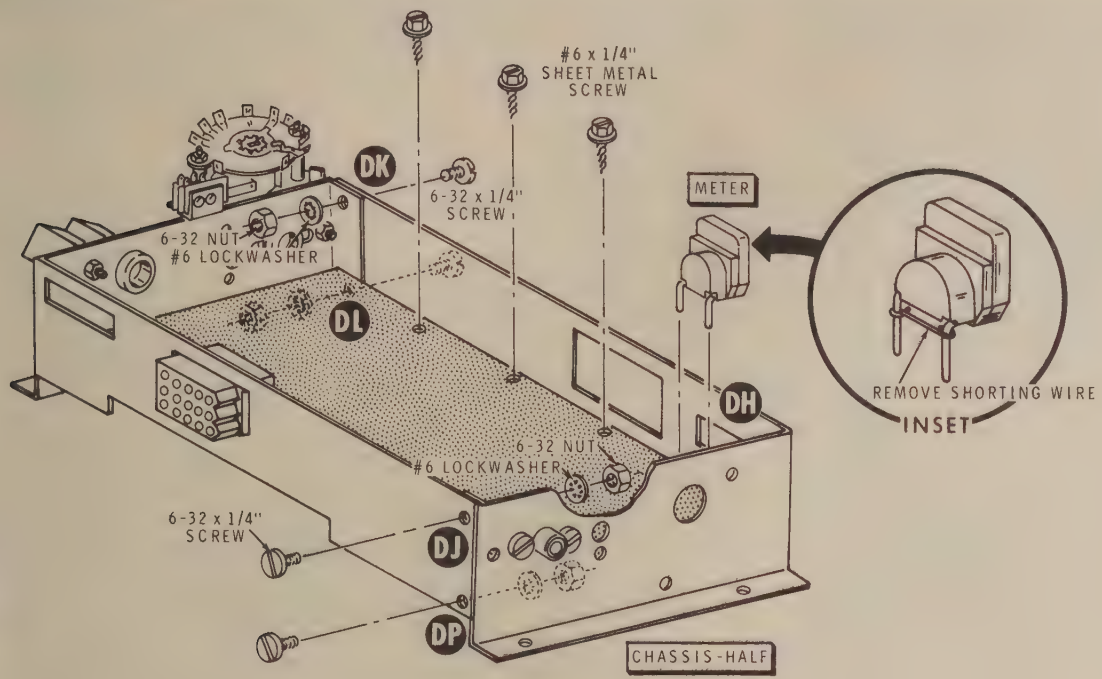
( ) Place the flange on this chassis-half under the edge of the receiver circuit board as shown. Then slide the chassis-half in place as shown by the two large arrows on the Detail.

CAUTION: Be very careful that you do not damage the switch wafer on the stepping relay when you turn the chassis assembly over to perform some of the steps on the following pages.

Refer to Detail 3-1G for the following steps.

( ) Secure the two chassis-halves together at DJ, DK, DL, and DP with 6-32 x 1/4" hardware.

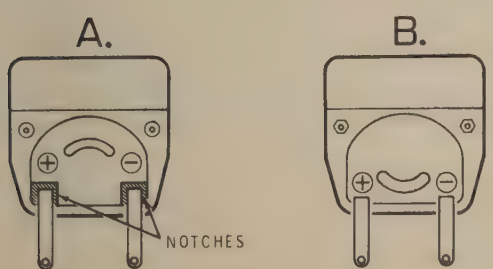
( ) Mount the circuit board to the flange of the chassis-half with three #6 x 1/4" sheet metal screws. Do not tighten these screws until directed to do so in a step.



Detail 3-1G

( ) Refer to the inset drawing on Detail 3-1G and remove the shorting wire between the solder lugs on the signal meter. (NOTE: This shorting wire may be very fine and positioned close to the meter case.)

( ) Refer to the following illustration and see which type of meter you have. If your meter looks like A, complete the steps in Detail A (fold-out from Page 27). If your meter looks like B, complete the steps in Detail B (foldout from Page 27).

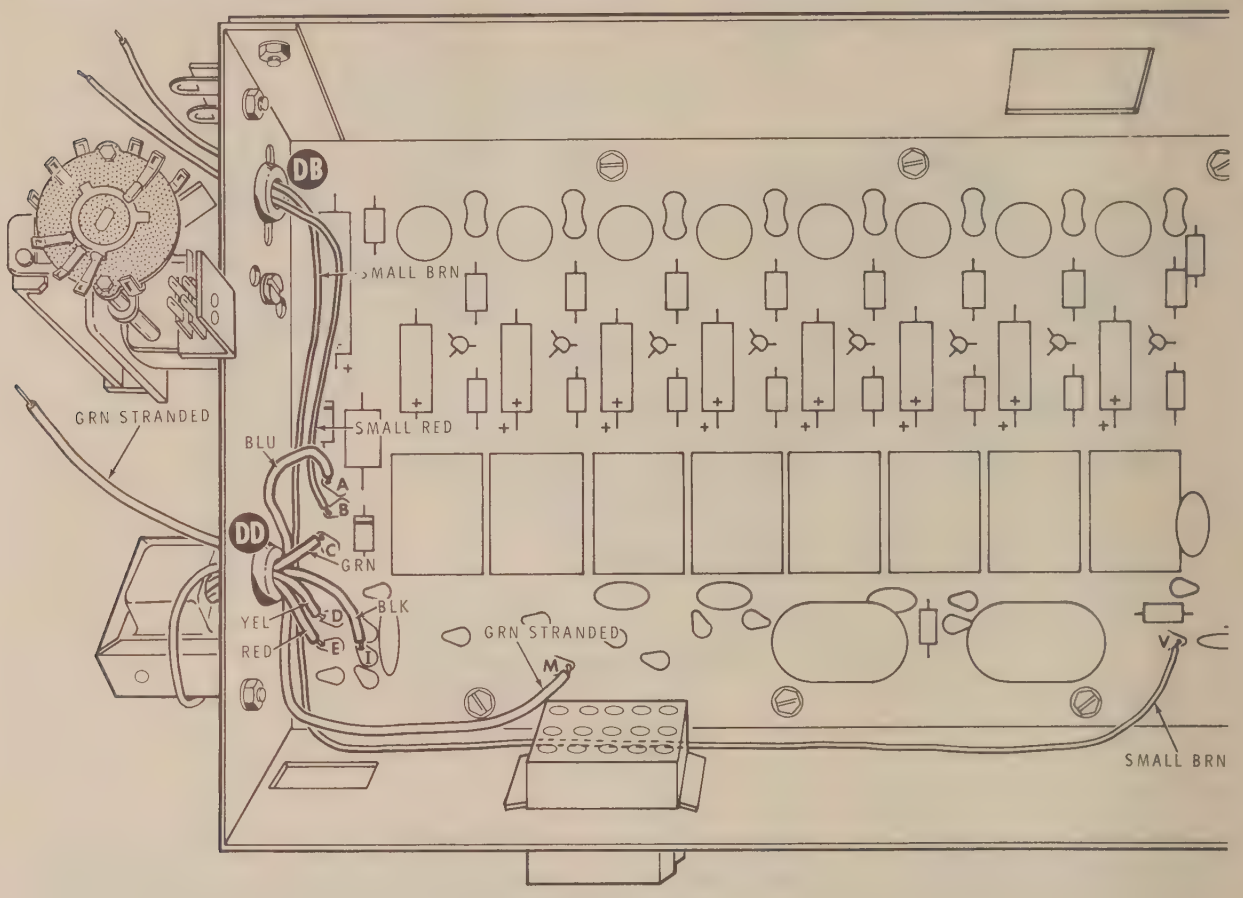


( ) Press the meter into position between the transformer and chassis. Be sure the meter solder lugs enter the corresponding holes in the circuit board. Press down on the meter until its face is seated in cutout DH.

( ) Now secure the circuit board to the chassis flange by tightening the three #6 x 1/4" sheet metal screws installed in a previous step.

CAUTION: In the next step, be very careful you do not damage the switch wafer on the stepping relay.

( ) Carefully turn the receiver over and solder the meter lugs to the circuit board foils.



PICTORIAL 3-2

Refer to Pictorial 3-2 for the following steps.

NOTE: Use hookup wire of the color specified when wire is called for in a step. Cut each wire to the proper length and remove 1/4" of insulation from each end. Position the wires as shown in the Pictorial.

( ) Insert one end of a 15-1/2" brown solid wire in hole V (S-1). Route this brown wire along the inside edge of the circuit board as shown and insert the free end through grommet DB for connection later.

NOTE: When you prepare a stranded wire, cut the wire to the proper length and remove 1/4" of insulation from each end. Then apply a small amount of solder to the ends of the wire to hold the fine strands together.

( ) Insert one end of a 7" green stranded wire in circuit board hole M (S-1). Insert the other end through grommet DD for connection later.

( ) Insert one end of a 6-1/2" red solid wire in circuit board hole B (S-1). Insert the other end through grommet DB for connection later.

Connect the power transformer leads coming from grommet DD in the following circuit board holes. Perform each step in the order listed; then solder the wire to the foil. After soldering, cut off any excess lead lengths.

WIRE COLOR	CIRCUIT BOARD HOLE
( ) Black	I (S-1).
( ) Red	E (S-1).
( ) Yellow	D (S-1).
( ) Green	C (S-1).
( ) Blue	A (S-1).

( ) Position each of the above wires down, out of the way in the corner formed by the end of the chassis and the circuit board.

Refer to Pictorial 3-3 (fold-out from Page 27) for the following steps.

Eleven of the fifteen wires coming from chassis connector DF will be inserted in circuit board holes as directed in the following steps. Perform each step in the order listed; then solder the wire to the foil. CAUTION: Be sure you do not damage the switch wafer on the stepping relay.

WIRE COLOR	CIRCUIT BOARD HOLE
( ) Violet	N (S-1).
( ) Green	P (S-1).
( ) Gray	Q (S-1).
( ) Brown	R (S-1).
( ) Black	F (S-1).
( ) Red	J (S-1).
( ) White-green	K (S-1).
( ) White-red	L (S-1).
( ) Yellow	U (S-1).
( ) Blue	T (S-1).
( ) White	S (S-1).

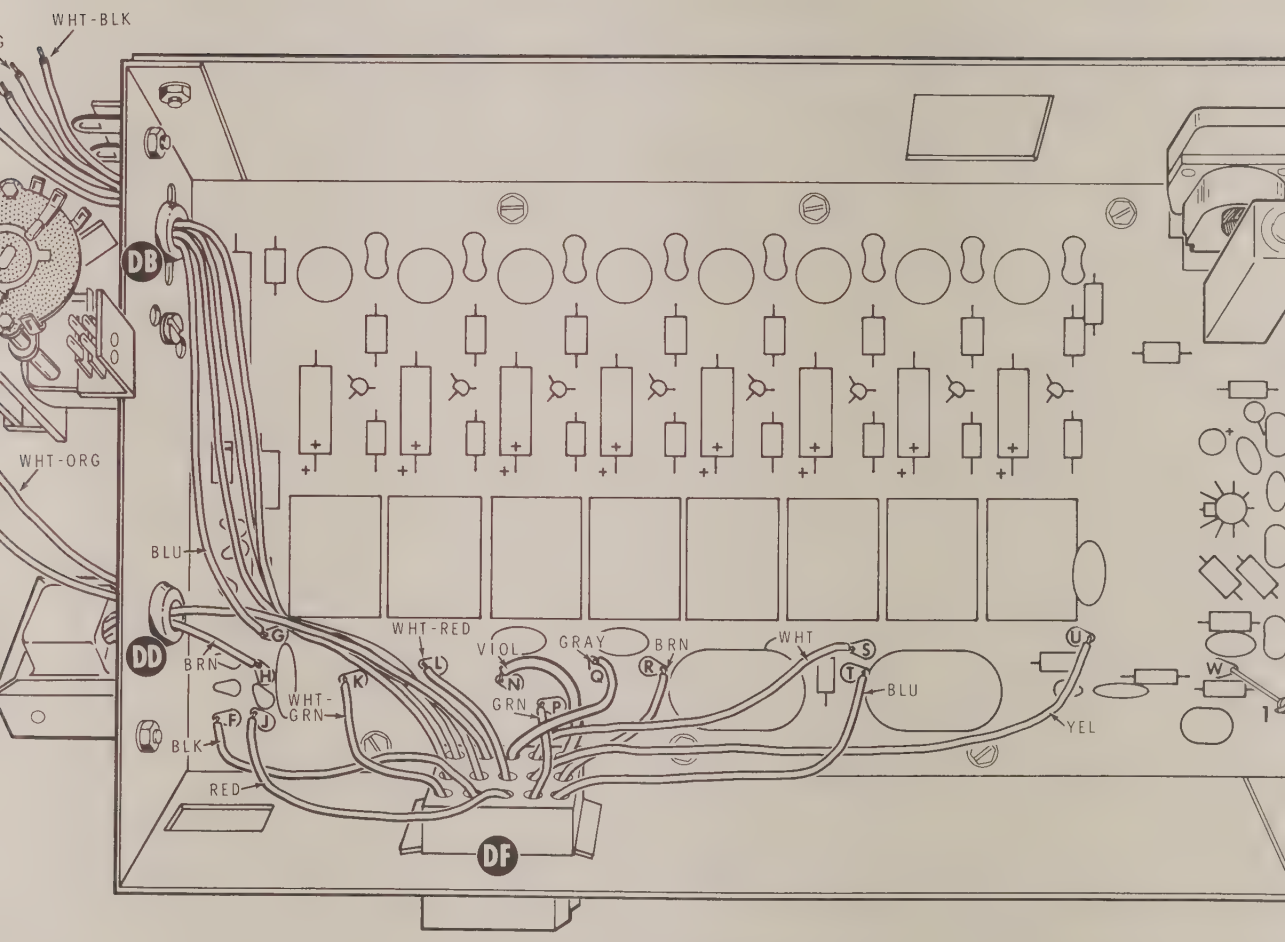
( ) Insert the free ends of the orange, white-blue, and white-black wires through grommet DB for connection later.

( ) Insert the free end of the white-orange wire through grommet DD for connection later.

( ) Remove the insulation from a 1-1/4" black solid wire. Connect this bare wire from lug 1 of phono socket DG (S-1) to circuit board hole W (S-1).

( ) Insert one end of a 4-1/2" brown stranded wire in circuit board hole H (S-1). Insert the other end through grommet DD for connection later.

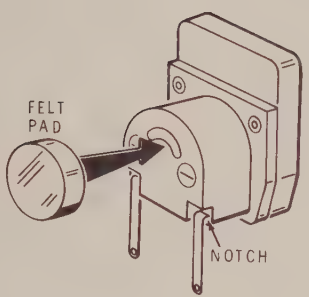
( ) Insert one end of an 8" blue stranded wire in circuit board G (S-1). Insert the other end through grommet DB for connection later.



PICTORIAL 3-3

Detail A

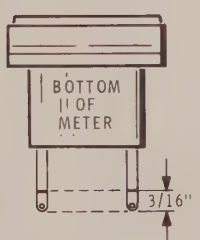
( ) Remove the backing paper from the round felt pad. Press the felt pad on the back of the meter case as shown.



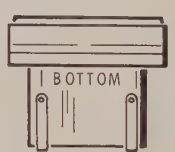
NOTE: The meter mounts between transformer T101 and the rear apron of the chassis as shown in Pictorial 3-1, with the felt pad pressed very firmly against the transformer. In the next step, exert only enough pressure against the transformer to allow the meter to be pushed down into place.

Detail B

Prepare the meter lugs as follows so they will mount properly into the circuit board:



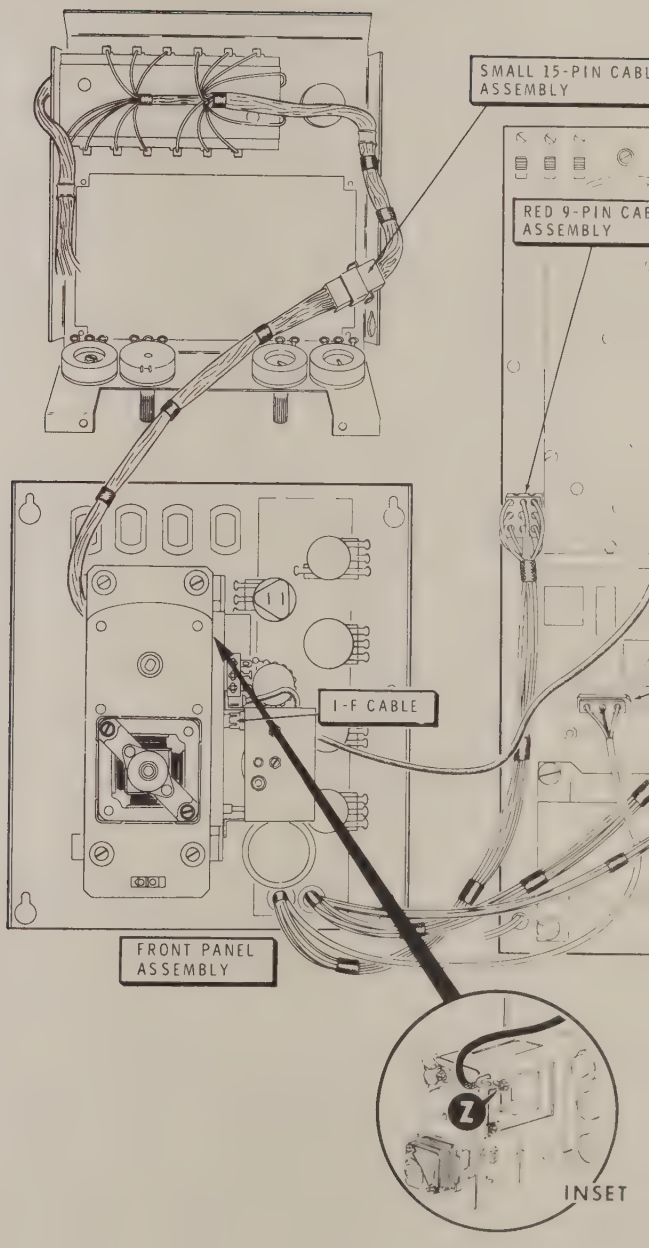
1. Make a pencil mark 3/16" from the end of each lug. Use a sharp pencil.

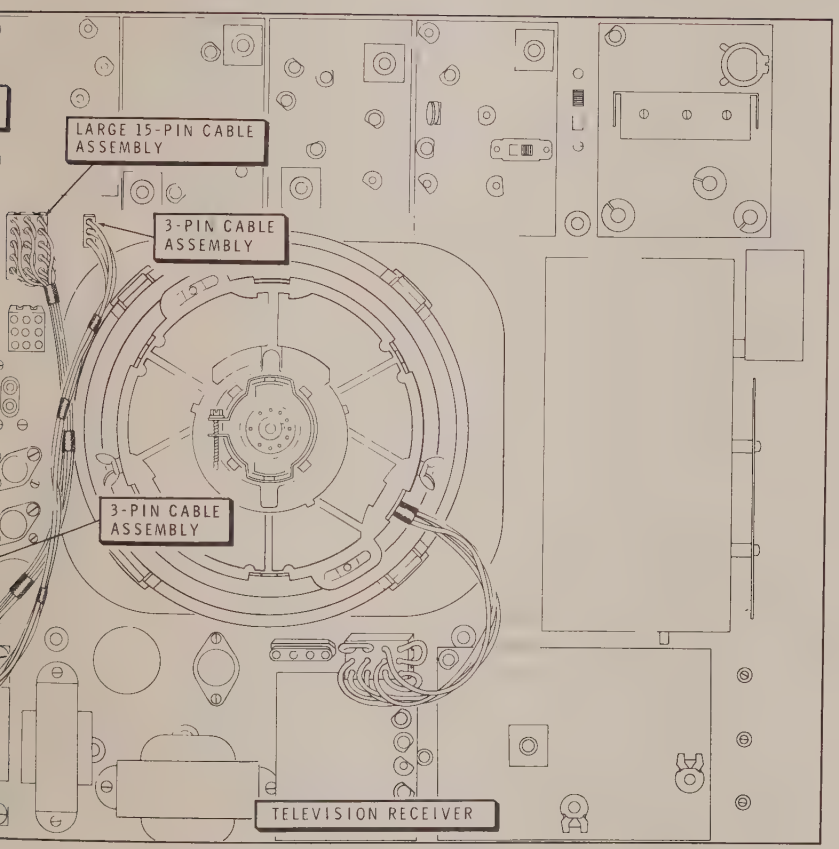


2. Bend the lugs flat against the meter.

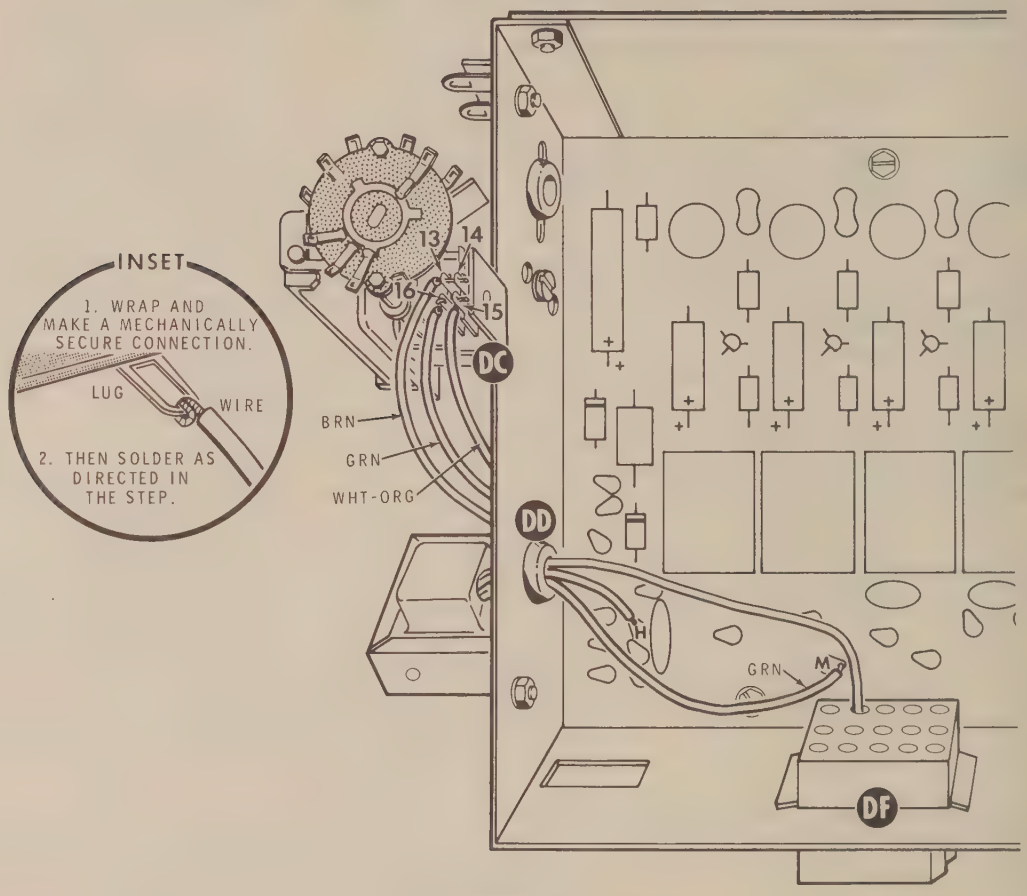
3. Bend each lug up at the mark. The bent part should point straight up from the meter case.

NOTE: The meter mounts between transformer T101 and the rear apron of the chassis as shown in Pictorial 3-1. In the next step, exert only enough pressure against the transformer to allow the meter to be pushed down into place.


SMALL 15-PIN CABL
ASSEMBLY
RED 9-PIN CAB
ASSEMBLY
I-F CABLE
FRONT PANEL
ASSEMBLY
Z
INSET


LARGE 15-PIN CABLE ASSEMBLY
3-PIN CABLE ASSEMBLY
3-PIN CABLE ASSEMBLY
TELEVISION RECEIVER

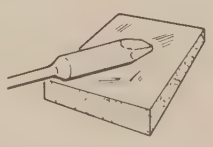
CTORIAL 4-1



PICTORIAL 3-4

FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN...

WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.



Refer to Pictorial 3-4 for the following steps.

The free ends of the wires coming from grommet DD will be connected in the following steps.

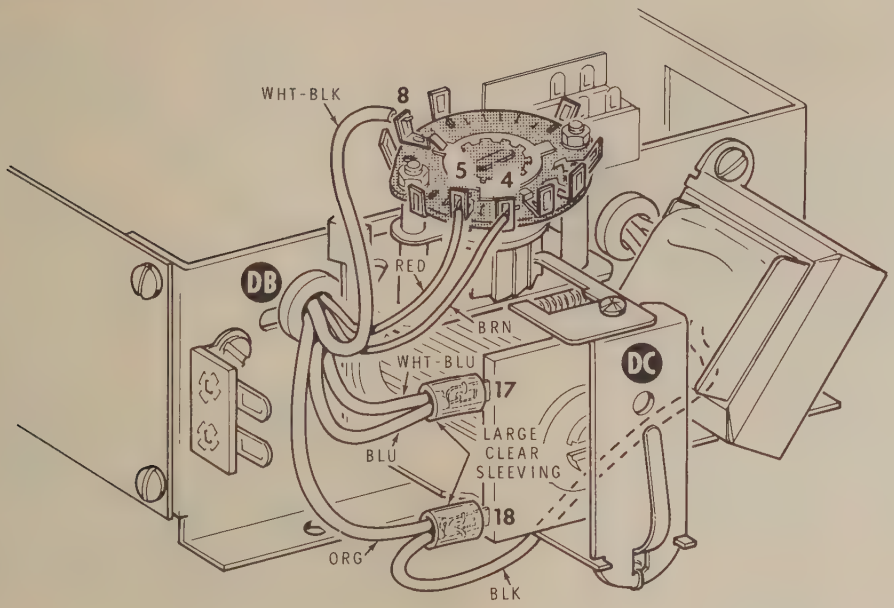
NOTE: Where a wire passes through a connection and then goes to another point, as in the next step, it will count as two wires in the solder instructions (S-2), one entering and one leaving the connection.

( ) Remove an additional 1/8" of insulation from the brown wire. Then insert this wire through lug 13 (S-2) to lug 14 (S-1) of stepping relay DC.

NOTE: In some of the following steps, you will be directed to "make a mechanically secure connection." Do this by inserting the wire through and/or wrapping it around the lug before soldering. See the inset drawing on Pictorial 3-4.

( ) Connect the white-orange wire to lug 15 of stepping relay DC (S-1). Make a mechanically secure connection.

( ) Connect the green wire to lug 16 of stepping relay DC (S-1). Make a mechanically secure connection.



PICTORIAL 3-5

Refer to Pictorial 3-5 for the following steps. Position each wire as shown.

NOTE: When you connect the black, orange, blue, and white-blue wires in the following steps, be sure you make a mechanically secure connection before soldering.

( ) Locate the black wire coming from the power transformer and the orange wire coming from grommet DB. Place them together and slide a 3/4" length of clear sleeving over both wires. Slide this sleeving away from the wire ends to keep it from melting during the following step.

( ) Connect both of these wires to lug 18 of stepping relay DC (S-2). Then push the sleeving over the soldered connection.

( ) In a like manner, place 3/4" of clear sleeving on the blue and the white-blue wires coming from grommet DB.

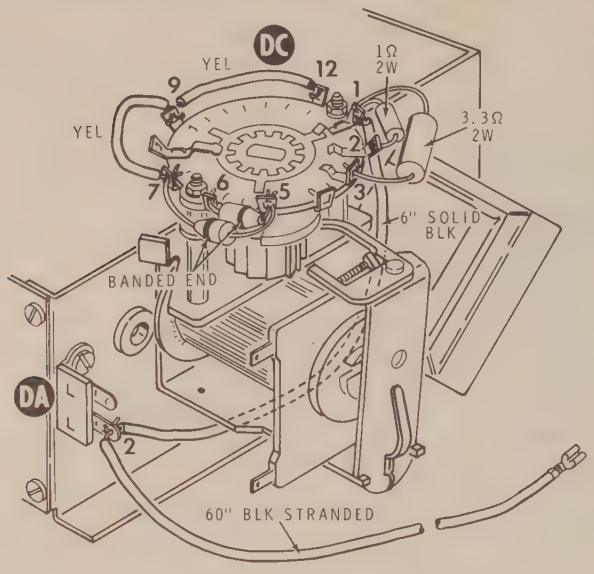
( ) Connect both of these wires to lug 17 of stepping relay DC (S-2). Then push the sleeving over the soldered connection.

Connect the remaining wires coming from grommet DB to stepping relay DC as follows:

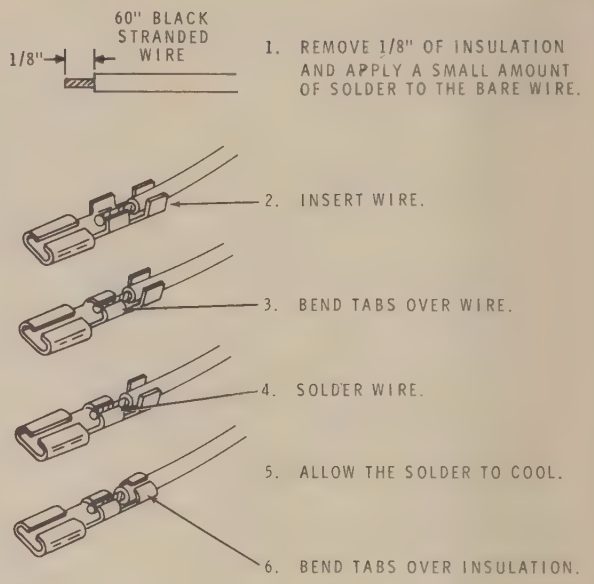
( ) Brown wire to lug 4 (S-1).

( ) Red wire to lug 5 (NS).

( ) White-black wire to lug 8 (S-1).



PICTORIAL 3-6


60" BLACK
STRANDED
WIRE
1/8"
1. REMOVE 1/8" OF INSULATION AND APPLY A SMALL AMOUNT OF SOLDER TO THE BARE WIRE.
2. INSERT WIRE.
3. BEND TABS OVER WIRE.
4. SOLDER WIRE.
5. ALLOW THE SOLDER TO COOL.
6. BEND TABS OVER INSULATION.

Detail 3-6A

Refer to Pictorial 3-6 for the following steps.

( ) Connect a 1-1/2" yellow solid wire between lug 12 (S-1) and lug 9 (NS) of stepping relay DC.

( ) Connect a 1-1/2" yellow solid wire between lug 9 (S-2) and lug 7 (NS) of stepping relay DC.

( ) Connect a 6" black solid wire from lug 1 of stepping relay DC (NS) to lug 2 of terminal strip DA (NS).

( ) Connect a 3.3 Ω (orange-orange-gold), 2-watt resistor between lug 3 (S-1) and lug 1 (NS) of stepping relay DC.

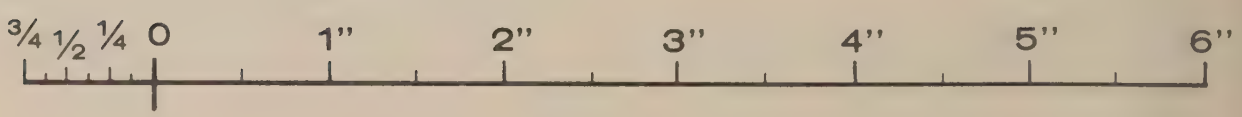
( ) Connect a 1 Ω (brown-black-gold), 2-watt, wire-wound resistor between lug 1 (S-3) and lug 2 (S-1) of stepping relay DC.

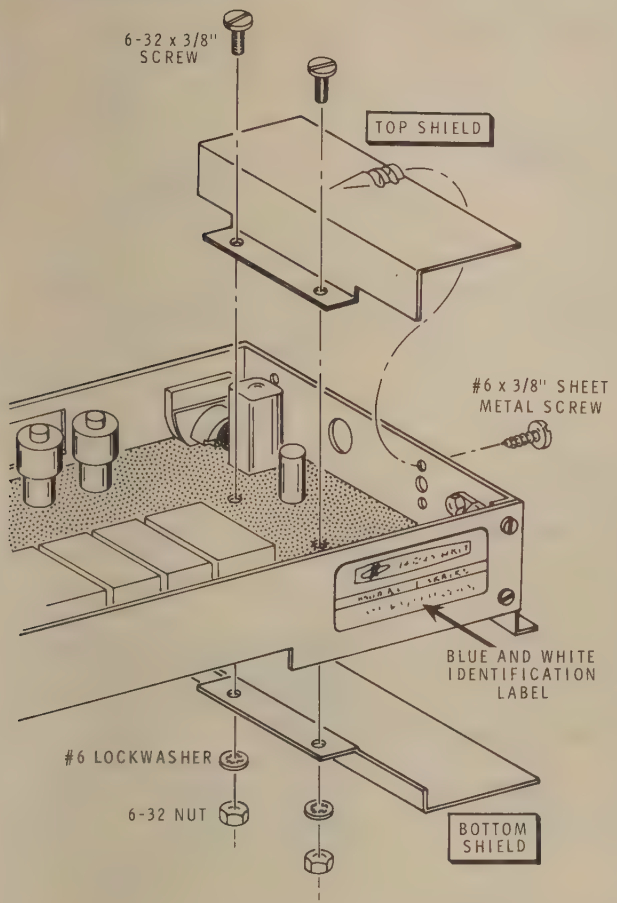
( ) Connect the lead from the banded end of a silicon diode (#57-27) to lug 5 of stepping relay DC (NS). Connect the other lead to lug 6 of the relay (S-1).

( ) Connect the lead from the banded end of a silicon diode (#57-27) to lug 7 of stepping relay DC (S-2). Connect the other lead to lug 5 of the relay (S-3).

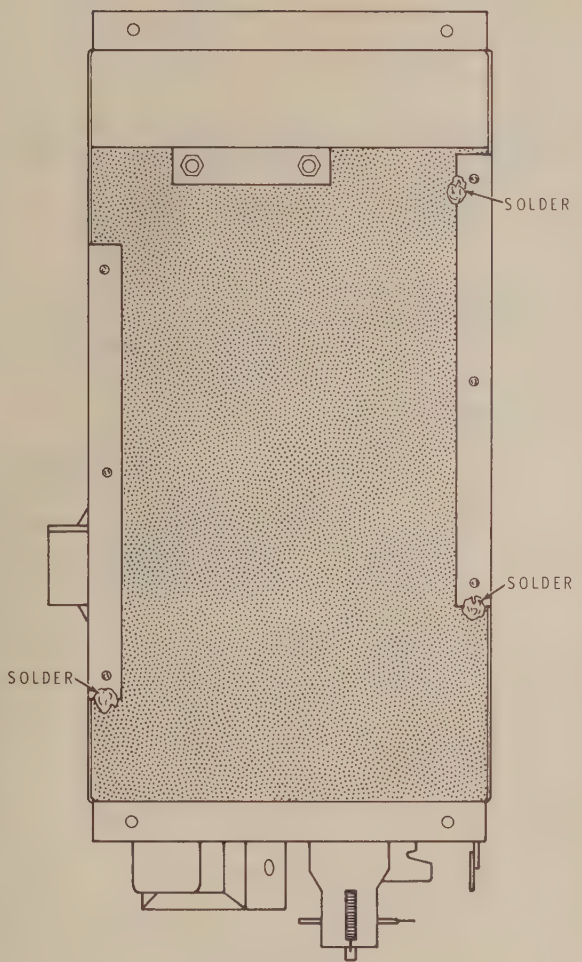
( ) Refer to Detail 3-6A and install a terminal connector on one end of a 60" black stranded wire.

( ) Remove 1/4" of insulation from the other end of the 60" black stranded wire. Connect this wire to lug 2 of terminal strip DA (S-2).





PICTORIAL 3-7



PICTORIAL 3-8

Refer to Pictorial 3-7 for the following steps.

( ) Mount the top shield and the bottom shield on the circuit board with 6-32 x 3/8" hardware as shown. Tighten the screws only finger tight.

( ) Secure the top shield to the chassis with a #6 x 3/8" sheet metal screw. Then tighten the two screws and secure the shields to the circuit board.

NOTE: The blue and white identification label, that will be installed in the next step, shows the model number and production series number of your kit. Refer to these numbers in any communications with the Heath Company; this assures you that you will receive the most up-to-date information in return.

( ) Carefully peel the backing paper from the blue and white identification label. Press the label on the receiver chassis as shown in Pictorial 3-7.

( ) Carefully turn the receiver over so the circuit board foil is up as shown in Pictorial 3-8. Be sure you do not damage the switch wafer on the stepping relay.

( ) Solder the foil to the circuit board mounting flanges at the three indicated locations.

This completes the assembly of the receiver. Shake out any bits of solder or wire that may have become lodged in the wiring. Also inspect the circuit board and remove any solder bridges between the foils, and solder any connections that might have been missed. Set the receiver aside until it is called for later.

TV SET MODIFICATION

If you purchased your Remote Control and TV Set at the same time, disregard this section of the Manual, as you will have already modified the TV Set (front panel assembly). Instead, turn to Page 52 and perform the step under "Receiver Adjustments."

If you purchased your Remote Control after you assembled your TV Set, proceed with this section of the Manual.

PARTS LIST

Open Pack #3 and check each part against the following list. The key numbers correspond to the numbers on the Parts Pictorial.

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
RESISTORS				
1/2-Watt				
A1	1-8	1	820 Ω (gray-red-brown)	.10
A1	1-11	2	1500 Ω (brown-green-red)	.10
A1	1-16	4	4700 Ω (yellow-violet-red)	.10
A1	1-18	1	5600 Ω (green-blue-red)	.10
A1	1-20	2	10 kΩ (brown-black-orange)	.10
A1	1-22	2	22 kΩ (red-red-orange)	.10
A1	1-26	2	100 kΩ (brown-black-yellow)	.10
A1	1-33	2	470 kΩ (yellow-violet-yellow)	.10
CAPACITORS				
B1	21-48	1	.05 μF disc	.15
B2	25-123	1	2 μF electrolytic	.40
DIODE-TRANSISTORS-IC				
C1	56-26	1	1N191 diode (brown-white-brown)	.25
C2	417-77	1	2N2712 transistor (blue dot)	.70
C2	417-118	1	2N3393 transistor	.40
C2	417-135	2	2N3859A transistor	.85
Diode-Transistors-IC (cont'd.)				
C2	417-94	2	2N3416 transistor	1.00
C2	417-235	2	2N4121 transistor	.60
C3	443-4	1	SN7472N integrated circuit (IC)	.90
MISCELLANEOUS				
D1	434-196	1	14-pin IC socket	.50
D2	434-195	7	Transistor socket	.10
E1	420-57	2	Motor	5.70
E2	205-599	2	Motor mounting plate	.15
E3	64-43	2	Pushbutton switch	.55
E4	207-22	1	1/2" cable clamp	.10
E5	432-73	6	Connector pin	.10
E6	250-52	6	4-40 x 1/4" screw	.05
E7	254-4	2	Control lockwasher	.05
E8	438-45	1	Wired jumper connector	.50
	134-273	1	15-conductor cable assembly	4.05
E9	253-89	1	"D" washer	.05
E10	432-66	1	Terminal connector	.10

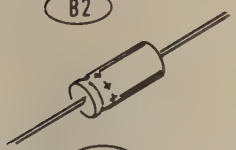
NOTE: See Page 67 for "Replacement Parts and Price Information."

PARTS PICTORIAL

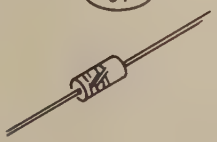
A1

B1

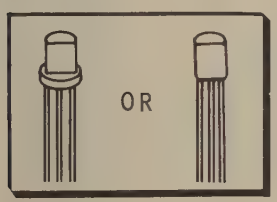
B2



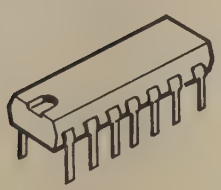
C1



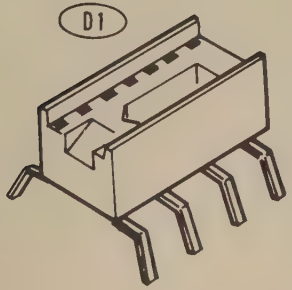
C2



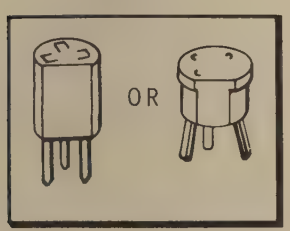
C3



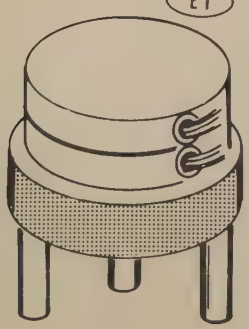
D1



D2

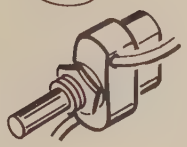


E1



E2

E3



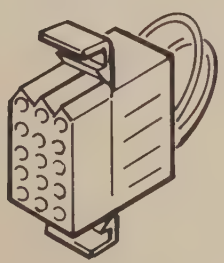
E4

E5

E6

E7

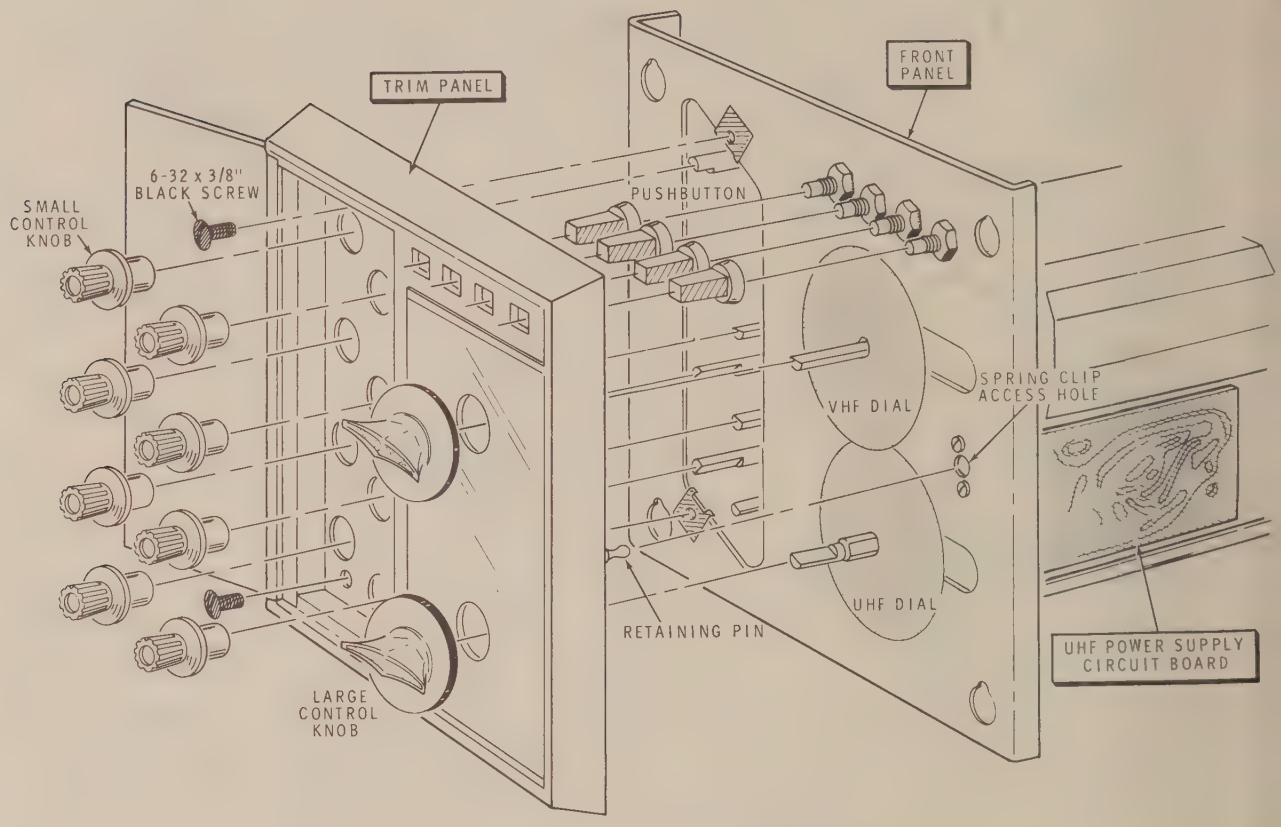
E8



E9

E10

STEP-BY-STEP ASSEMBLY



PICTORIAL 4-2

REMOVING FRONT PANEL ASSEMBLY

Refer to Pictorial 4-1 (fold-out from Page 28) for the following steps. Also refer to Book 4 of the Assembly Manuals of your Keathkit TV Set.

( ) Turn the TV Set ON-OFF/BRIGHT control counterclockwise until the switch clicks off. Then disconnect the line cord from the power outlet and the antenna leads from the TV Set.

( ) Unplug both 3-pin cable connector assemblies from the TV Set.

( ) Unplug the small 15-pin cable connector assembly from the TV Set.

( ) Unplug the large 15-pin cable connector assembly from the TV Set.

( ) Unplug the red 9-pin cable connector assembly from the TV Set.

( ) Unplug the i-f cable from the VHF tuner in the front panel assembly.

( ) Refer to the inset drawing on the Pictorial and loosen the screw at Z on the tuner panel. Then disconnect the ground lead and tighten the screw.

( ) Remove the screw near the UHF terminals on the antenna board and remove the board from the enclosure.

( ) Loosen the front panel assembly mounting screws. Then lift the assembly slightly and remove it from its mounting position.

Refer to Pictorial 4-2 for the following steps.

( ) Pull the knobs off the control shafts that protrude through the trim panel on the front panel assembly.

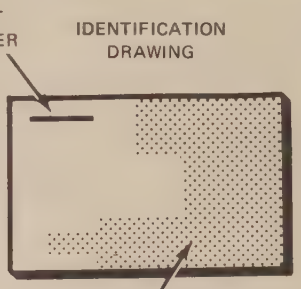
CAUTION: The trim panel holds the four pushbuttons in place. Be sure you do not lose one of them when you remove the trim panel in the next step.

( ) Remove the two 6-32 x 3/8" black screws through the trim panel behind the knob access door. Then press outward on the pin in the spring clip on the rear of the front panel and remove the trim panel. Place the knobs, screws, and trim panel aside until they are called for later.

NOTE: The UHF Power Supply circuit board is plugged into a 15-pin connector and mounting bracket assembly that is mounted in the open area of the tuner panel as shown.

( ) Being careful to avoid damage to the circuit board, unplug the UHF power supply from its connector. Then perform the steps in Pictorials 4-3 through 4-5 on the following pages.

UHF POWER SUPPLY ASSEMBLY

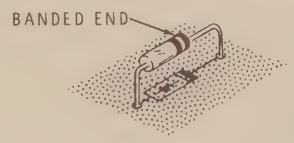


The steps performed in this Pictorial are in the shaded area of the circuit board.

START

Position the uhf power supply board with its part number as shown in the identification drawing. Then complete each step in the Pictorial.

NOTE: When you install a diode, be sure you position the banded end as shown on the circuit board.



( ) Germanium diode (#56-26, brown-white-brown) at D902.

( ) 820 Ω (gray-red-brown).

( ) 1500 Ω (brown-green-red).

( ) 100 kΩ (brown-black-yellow).

( ) 5600 Ω (green-blue-red).

( ) 4700 Ω (yellow-violet-red).

( ) 4700 Ω (yellow-violet-red).

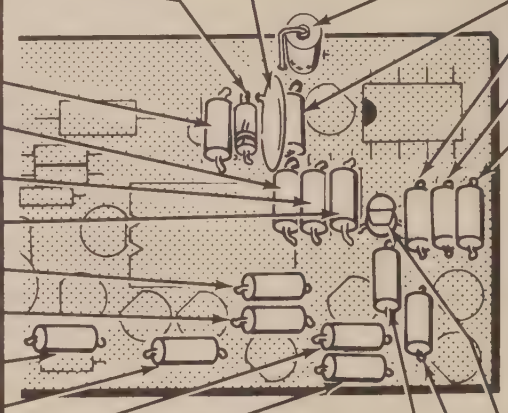
( ) 1500 Ω (brown-green-red).

( ) 4700 Ω (yellow-violet-red).

( ) 22 kΩ (red-red-orange).

( ) 4700 Ω (yellow-violet-red).

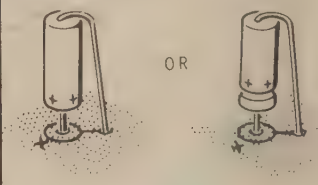
( ) Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

( ) .05 μF disc.

NOTE: When you install electrolytic capacitors, be sure the positive (+) marked end matches the positive (+) mark on the circuit board.



( ) 2 μF electrolytic.

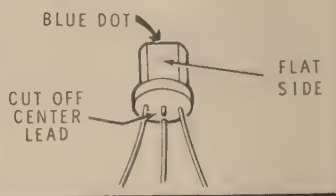
( ) 100 kΩ (brown-black-yellow).

( ) 470 kΩ (yellow-violet-yellow).

( ) 10 kΩ (brown-black-orange).

( ) 10 kΩ (brown-black-orange).

( ) Locate the blue dot transistor (#417-77) and cut off the center lead as shown.



( ) Install the prepared blue dot transistor at D903. Be sure you position the flat side as shown on the circuit board.

( ) 22 kΩ (red-red-orange).

( ) 470 kΩ (yellow-violet-yellow).

( ) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 4-3

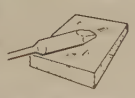
IDENTIFICATION DRAWING

PART NUMBER

The steps performed in this Pictorial are in the shaded area of the circuit board.

START

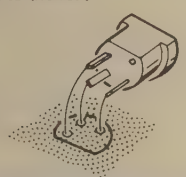
FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN...



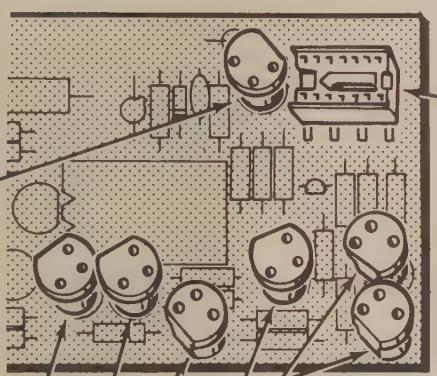
WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

NOTE: Solder each part to the foil as the part is installed on the circuit board.

( ) Line up the flat of a transistor socket with the outline of the flat on the circuit board at location Q903. Insert the lugs in the holes in the circuit board; then solder the lugs to the foil.



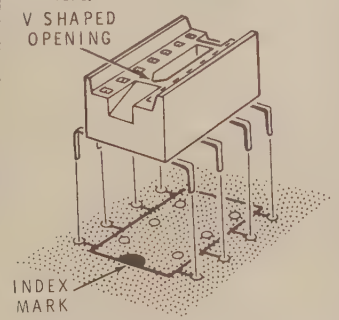
( ) In a like manner, install transistor sockets at the remaining six transistor locations.



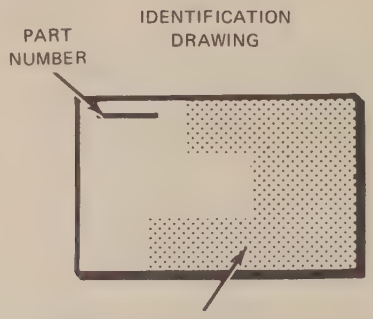
CONTINUE

NOTE: There is a rectangular opening in the center of the IC socket that will be installed in the next step. Position the socket so the V shaped end of the opening is toward the index mark on the circuit board.

( ) 14-pin IC socket at IC902. Insert the socket pins into the circuit board holes; then solder the pins to the foils.



PICTORIAL 4-4



START

NOTE: Four types of transistors will be installed on the uhf power supply board. Prepare and install three types as shown in Detail 4-5A. Prepare and install the fourth type as shown in Detail 4-5B.

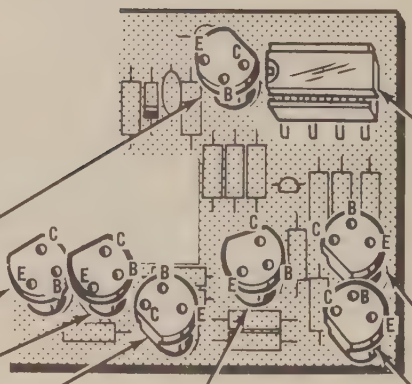
( ) 2N3393 transistor (#417-118) at Q903. See Detail 4-5A.

( ) 2N3416 transistor (#417-94) at Q909. See Detail 4-5A.

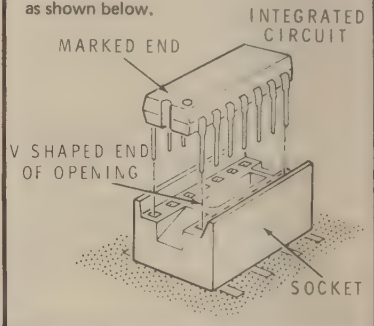
( ) 2N3416 transistor (#417-94) at Q908. See Detail 4-5A.

( ) 2N4121 transistor (#417-235) at Q906. See Detail 4-5B.

( ) 2N4121 transistor (#417-235) at Q905. See Detail 4-5B.



CAUTION: The marked (notched or dimpled) end of the IC must be positioned at the same end of the socket as the V-shaped end of the rectangular opening as shown below.



( ) SN7472N integrated circuit (#443-4) at IC902. Insert the IC pins in the corresponding holes in the socket. Then press the IC firmly down into the socket.

( ) 2N3859A transistor (#417-135) at Q904. See Detail 4-5A.

( ) 2N3859A transistor (#417-135) at Q907. See Detail 4-5A.

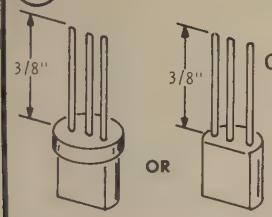
( ) Set the circuit board aside temporarily.

FINISH

PICTORIAL 4-5

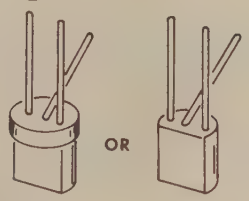
This applies to transistors 2N3393 (#417-118), 2N3859A (#417-135) and 2N3416 (#417-94).

1



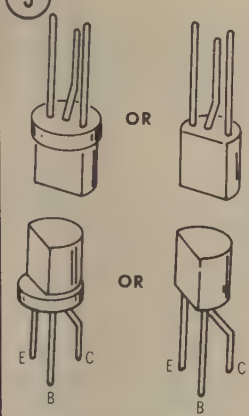
Cut the transistor leads to 3/8".

2



Bend the center lead at a 45° angle. CAUTION: The lead must be bent away from the flat side of the transistor.

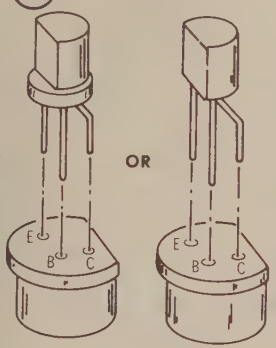
3



Now bend half of the center lead until it is straight again.

When the transistor is positioned with the flat side as shown, the leads are identified as E (emitter), C (collector), and B (base). Be sure you note this identification when a transistor is installed in its socket.

4

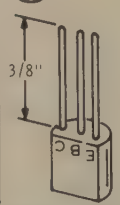


The lettering for the transistor socket (holes E, B, and C) is printed on the circuit board. Insert the formed center lead in socket hole C and the other two leads in holes E and B, respectively. NOTE: When the transistor is properly installed it should be about 1/8" above the socket. Be sure the transistor leads do not touch each other.

Detail 4-5A

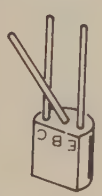
This applies only to a 2N4121 transistor, #417-235.

1



Cut the transistor leads to 3/8".

2



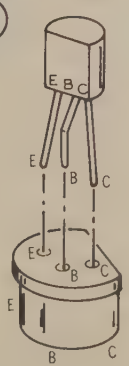
Bend the center lead to a 45° angle. CAUTION: The lead must be bent toward the flat side of the transistor.

3

Now bend half of the center lead until it is straight again.

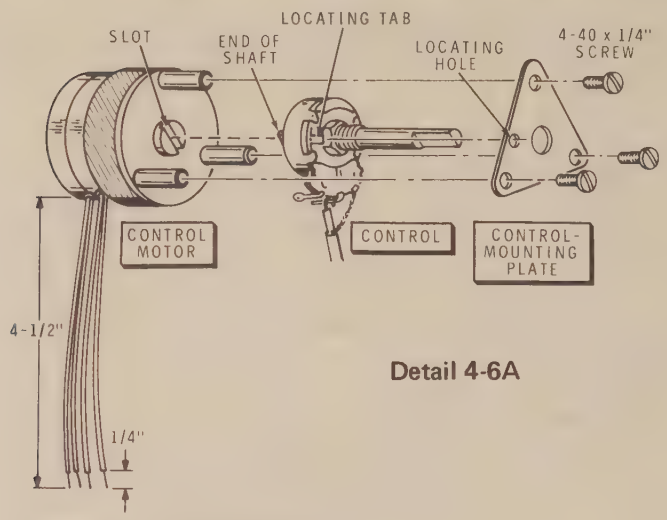
When the transistor is positioned with the flat side as shown, the leads are identified as E (emitter), B (base), and C (collector). Be sure you note this identification when you install one of these two transistors.

4



The lettering for the transistor socket (holes E, B, and C) is printed on the circuit board. Insert the formed center lead in socket hole B and the other two leads in holes E and C respectively. NOTE: When the transistor is properly installed it should be about 1/8" above the socket. Be sure the transistor leads do not touch each other.

Detail 4-5B



Detail 4-6A

INSTALLING MOTORS

Refer to Pictorial 4-6 (fold-out from Page 43) for the following steps.

( ) Refer to Detail 4-6A and cut the leads of both control motors to 4-1/2". Remove 1/4" of insulation from the end of each lead, twist the small strands together, and apply a small amount of solder to hold the fine strands together.

NOTE: In the following steps, motors will be mounted at the back of the "tint" and the "color" controls. Be careful that you do not break off one of the wires connected to one of the controls.

( ) Remove the control nut that secures the Tint control. Then carefully remove the control from the control bracket. Be sure you do not lose the control lockwasher and nut.

( ) Refer to Detail 4-6A and place a control mounting plate on the control. The plate must be positioned as shown for proper alignment of the motor and control.

( ) Position a control motor at the back of the Tint control with the end of the control shaft seated in the slot of the motor. CAUTION: Be sure the motor leads, control leads, and locating hole in the control mounting plate are positioned in relation to each other as shown in Detail 4-6A.

( ) Secure the mounting plate to the flanged spacers on the motor with 4-40 x 1/4" screws. The locating tab on the control should be in the locating hole in the mounting plate with the flanged spacers seated in the mounting plate holes.

( ) Refer to Detail 4-6B and mount the control assembly with the control lockwasher and control nut previously removed. Be sure the control and motor assembly is positioned as shown and no wires are pinched under the assembly.

( ) Remove the control nut that secures the Color control. Then carefully remove the control from its mounting bracket. Be sure you do not lose the control lockwasher and nut.

( ) Refer to Detail 4-6A and, in the same manner, mount the remaining motor at the rear of the Color control with a mounting plate and 4-40 x 1/4" hardware. The wires from both motors will be connected later.

( ) Refer to Detail 4-6B and mount this assembly with the control lockwasher and control nut previously removed. Position it as shown and make sure no wires are pinched under the assembly.

FRONT PANEL ASSEMBLY WIRING

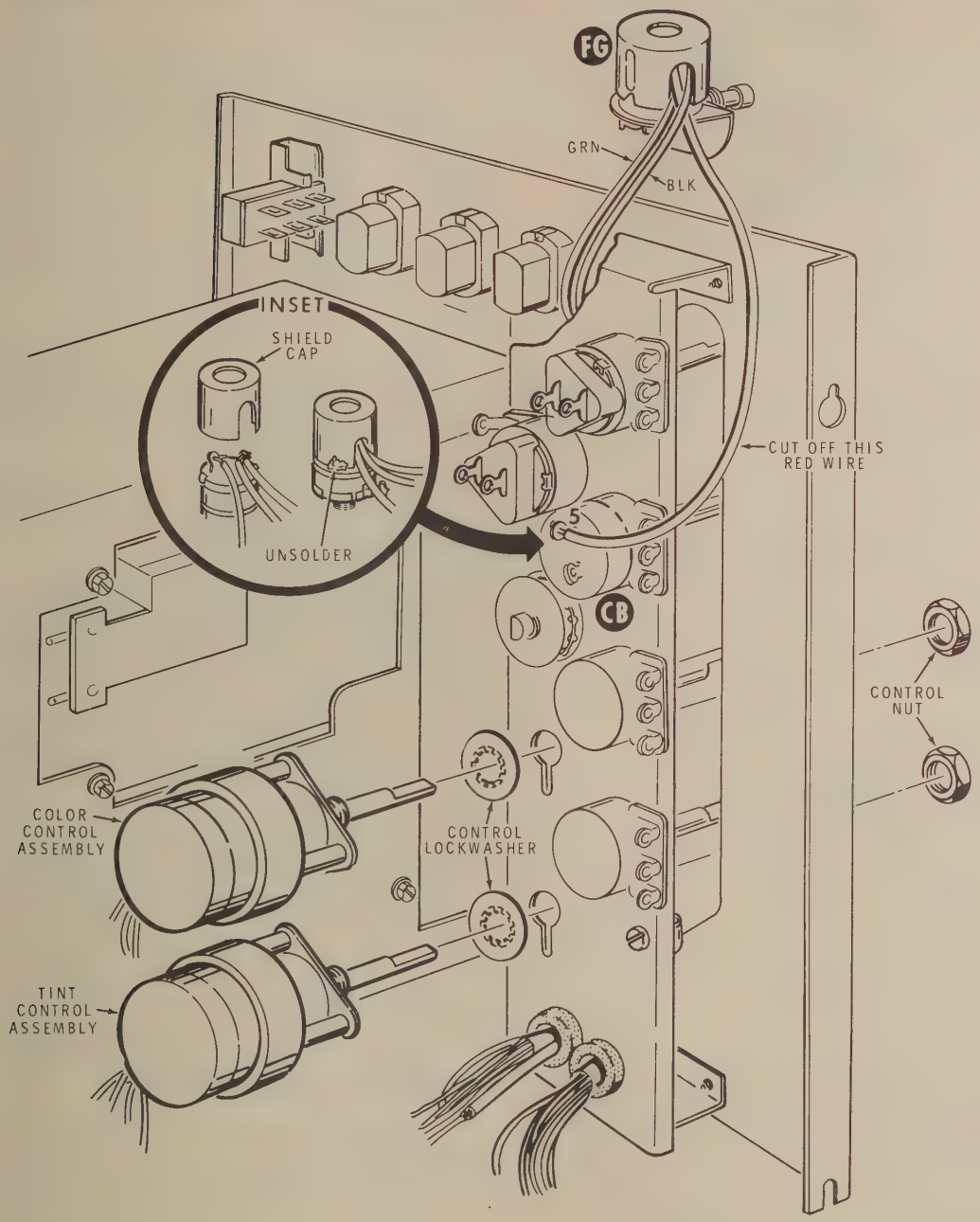
Refer to Pictorial 4-6 (fold-out from Page 43) for the following steps.

( ) Refer to the inset drawing on Detail 4-6B and remove the shield cap from switch CB.

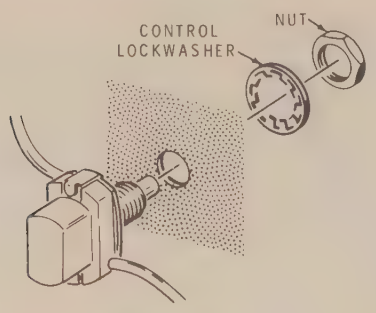
( ) Cut the red stranded wire coming from switch FG off of lug 5 of switch CB. Do not cut off the other red wire connected to lug 5.

( ) Replace the shield cap on switch CB and solder the cap to the switch.

( ) Referring to Pictorial 4-6, remove pushbutton switch FG from the front panel. Position the switch and wires up out of the way as shown in Detail 4-6B.


FG
GRN
BLK
INSET
SHIELD CAP
UNSOLDER
CUT OFF THIS RED WIRE
5
CB
CONTROL NUT
COLOR CONTROL ASSEMBLY
CONTROL LOCKWASHER
TINT CONTROL ASSEMBLY

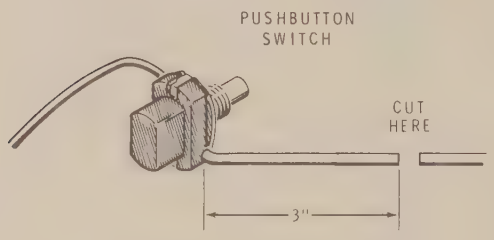
Detail 4-6B



Detail 4-6C

( ) Refer to Detail 4-6C and install a new pushbutton switch (#64-43) in the front panel at FG. Use a control lockwasher and the nut supplied with the switch.

( ) Referring to Pictorial 4-6, remove and discard the hardware that secures pushbutton switch FF to the front panel. Then move this switch and its wires back out of the way. A new pushbutton switch will be installed at this location.



Detai 4-6D

( ) Refer to Detail 4-6D and cut one lead of the remaining new pushbutton switch to 3". Then remove 1/4" of insulation from the shortened lead.

( ) Refer to Detail 4-6C and the inset drawing on Pictorial 4-7 and install this new pushbutton switch in the front panel at FF. The switch leads will be connected later.

Refer to Pictorial 4-7 (fold-out from Page 43) for the following steps.

( ) Refer to Detail 4-7A and loosen the two bronze screws at A and C. Then remove and save the 6-32 x 3/8" screw and fiber washer at B and remove the insulating paper. The insulator will be installed later.

NOTE: The green and the black stranded wires still attached to unmounted pushbutton switch FG will be disconnected from lugs 1 and 2 of terminal strip FT in the following steps. CAUTION: Be sure you identify the proper green and black wires.

( ) Follow the green wire from unmounted switch FG to lug 1 of terminal strip FT. See Detail 4-7B. Cut off (or unsolder and remove) this green wire from lug 1.

( ) Follow the black wire from unmounted switch FG to lug 2 of terminal strip FT. Cut off (or unsolder and remove) this black wire from lug 2.

( ) Cut off the soldered portion at the ends of the green and black wires. Then remove the switch and wires from the front panel assembly, as they will not be used.

( ) Route the leads from new pushbutton switch FG down past the open side of the tuner panel to terminal strip FA.

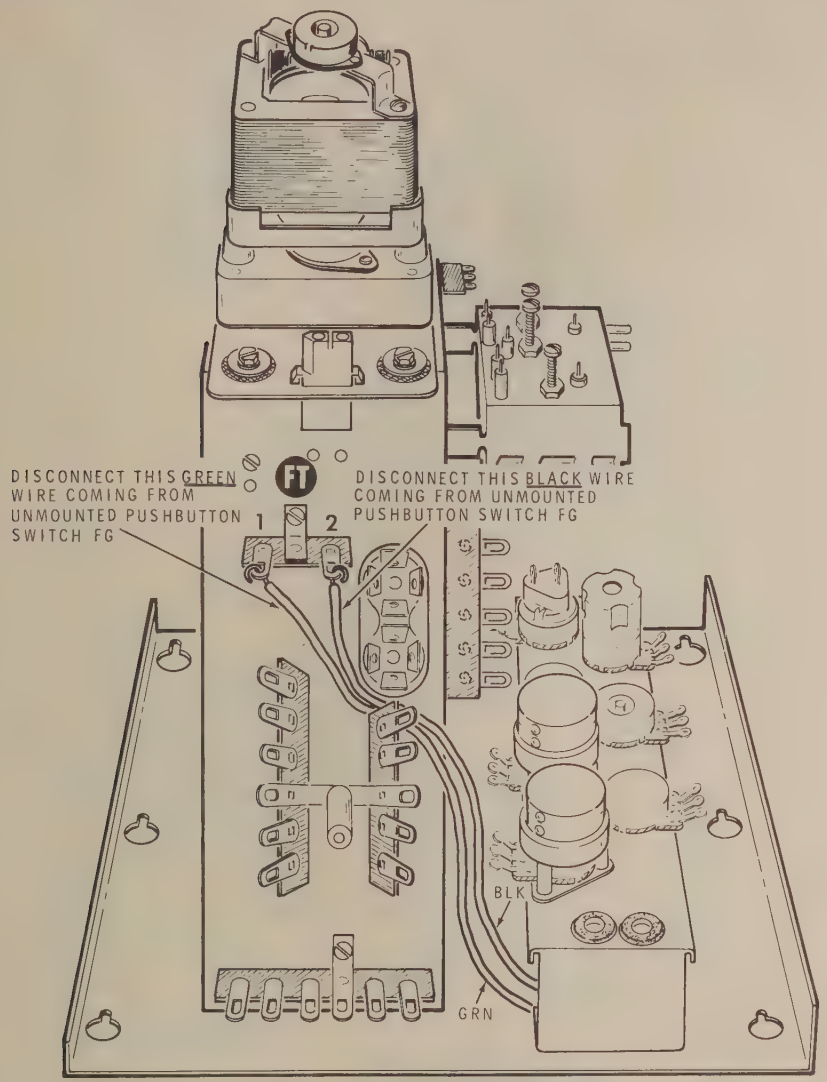
NOTE: In the following steps, some of the lugs on the terminal strips will already have wires soldered to them. The soldering instruction (S-1), (S-2), etc., will indicate the total number of wires that should be connected to that lug.

( ) Connect one lead coming from switch FG to lug 3 of terminal strip FA (S-4).

( ) Connect the other lead coming from switch FG to lug 5 of terminal strip FA (NS).

( ) Remove the black wire from the chassis lug on the top of the tuner panel. NOTE: This black wire is also connected to unmounted pushbutton switch FF.

( ) Connect the short lead from new pushbutton switch FF to the tuner panel chassis lug (S-1). See the inset drawing on Pictorial 4-7.



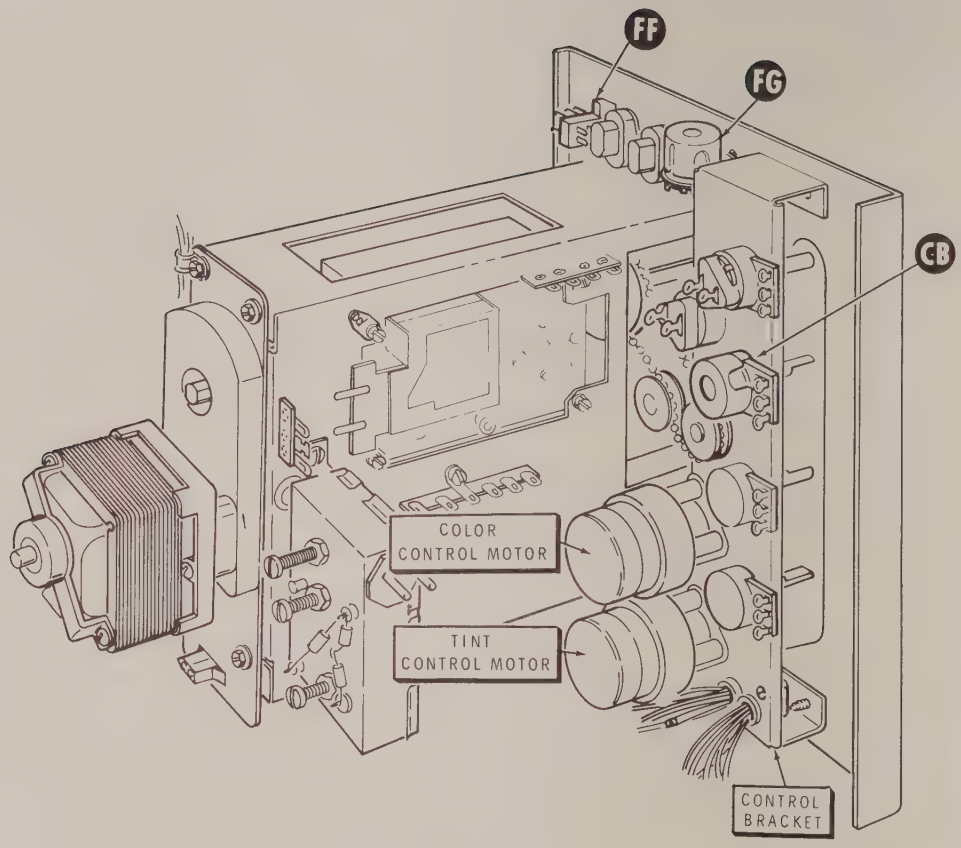
Detail 4-7B

( ) Connect the other lead from new switch FF to the eyelet of lug 1 on terminal strip FB (S-1).

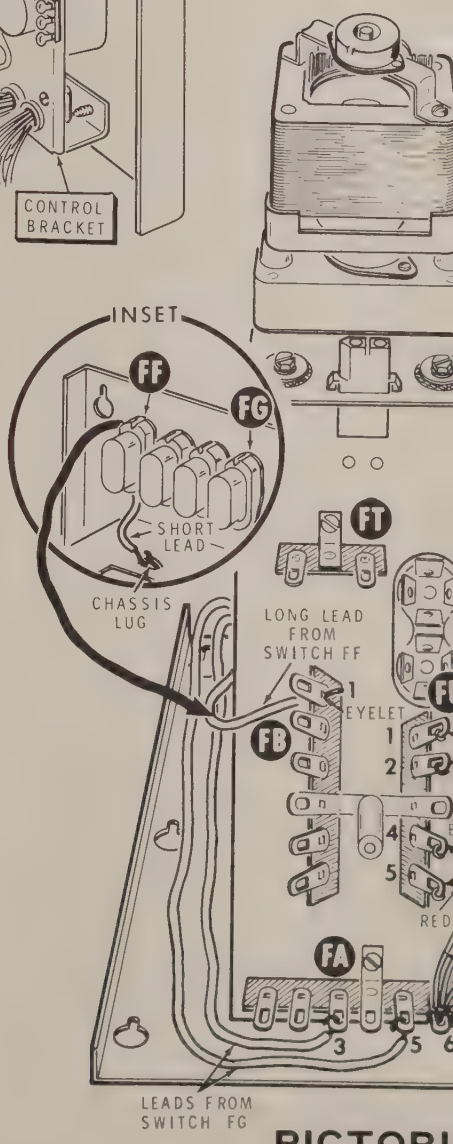
( ) Connect the white wires coming from motors CG and CH to lug 6 of terminal strip FA (S-6). There should now be four white wires and two orange wires connected to lug 6.

( ) Connect the red wire from motor CH to lug 5 (NS) and the brown wire to lug 4 (NS) of terminal strip FU.

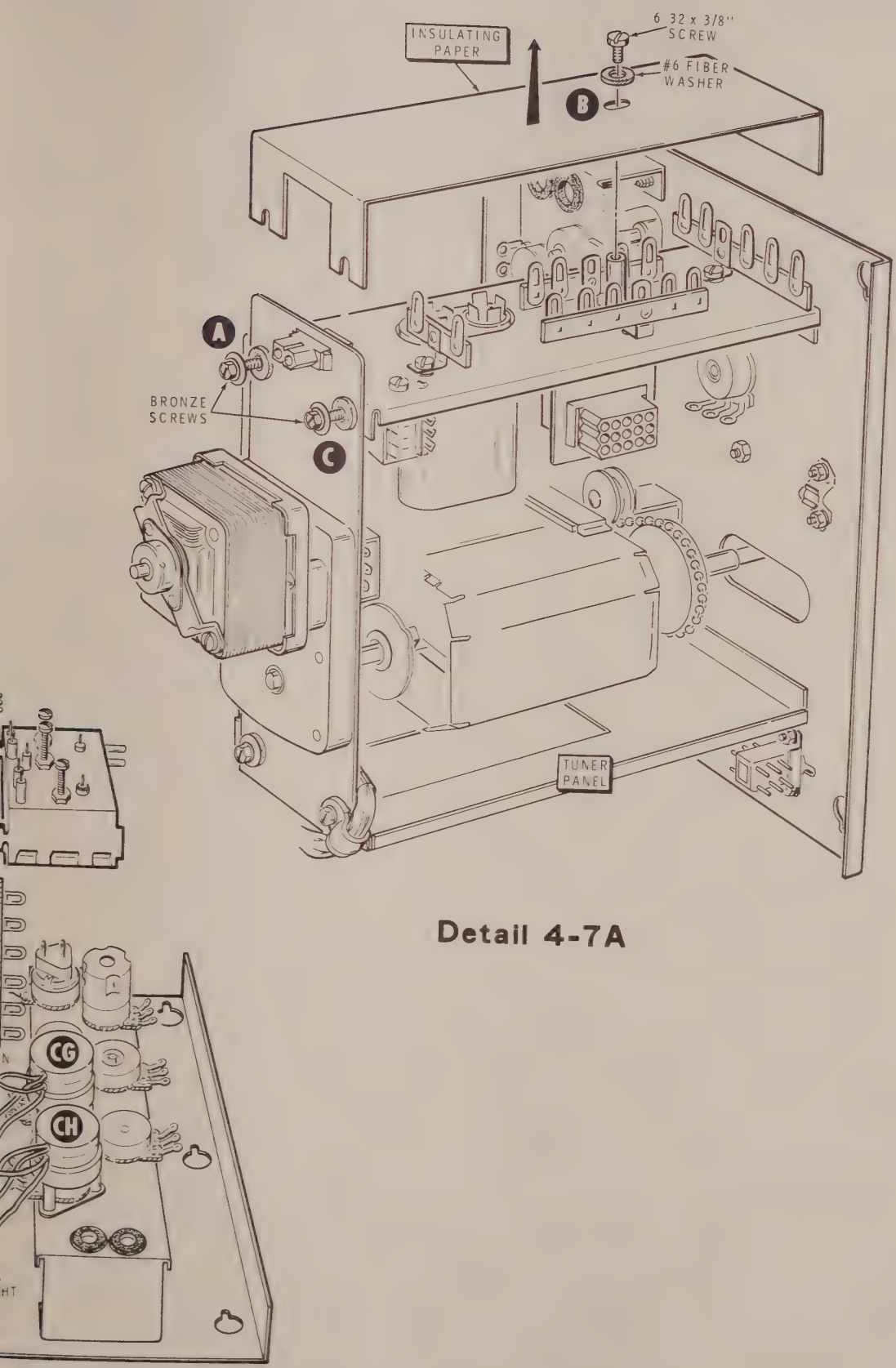
( ) Connect the red wire from motor CG to lug 2 (NS) and the brown wire to lug 1 (NS) of terminal strip FU.



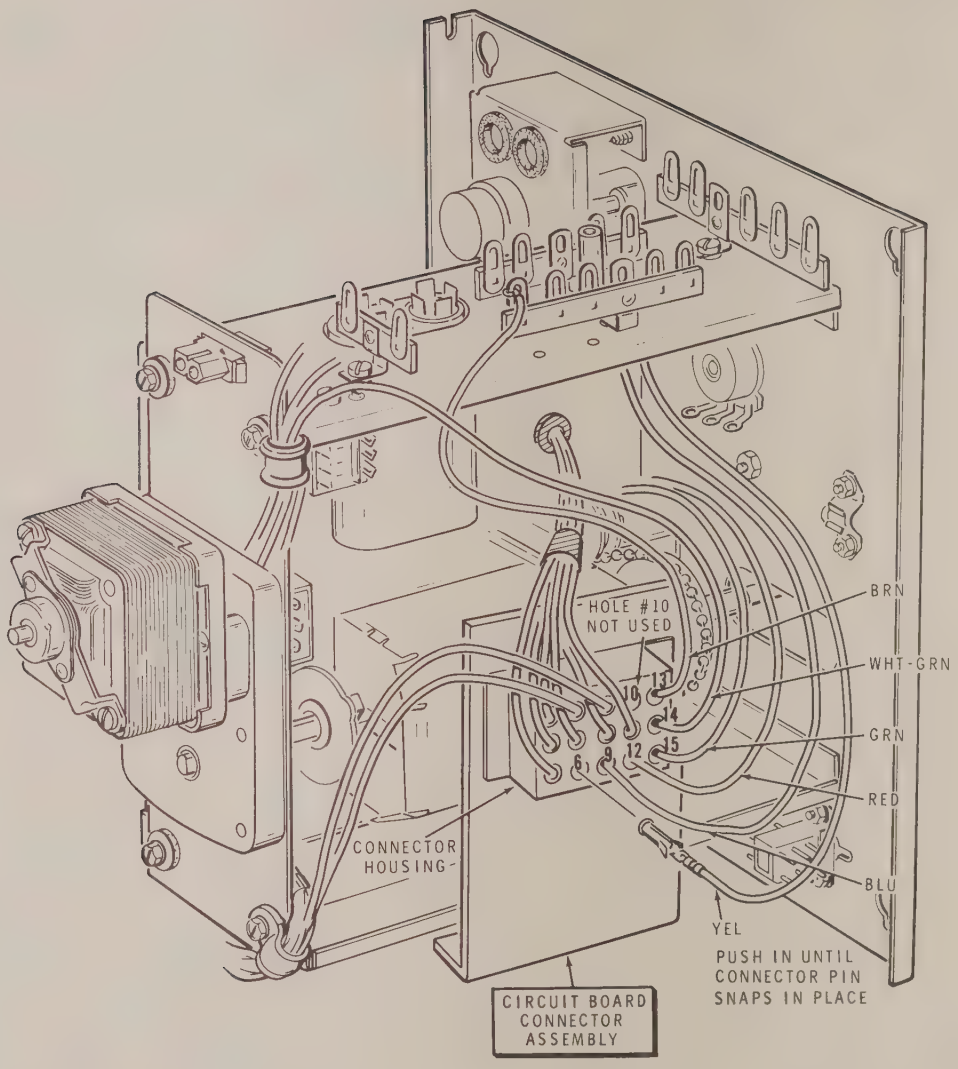
PICTORIAL 4-6



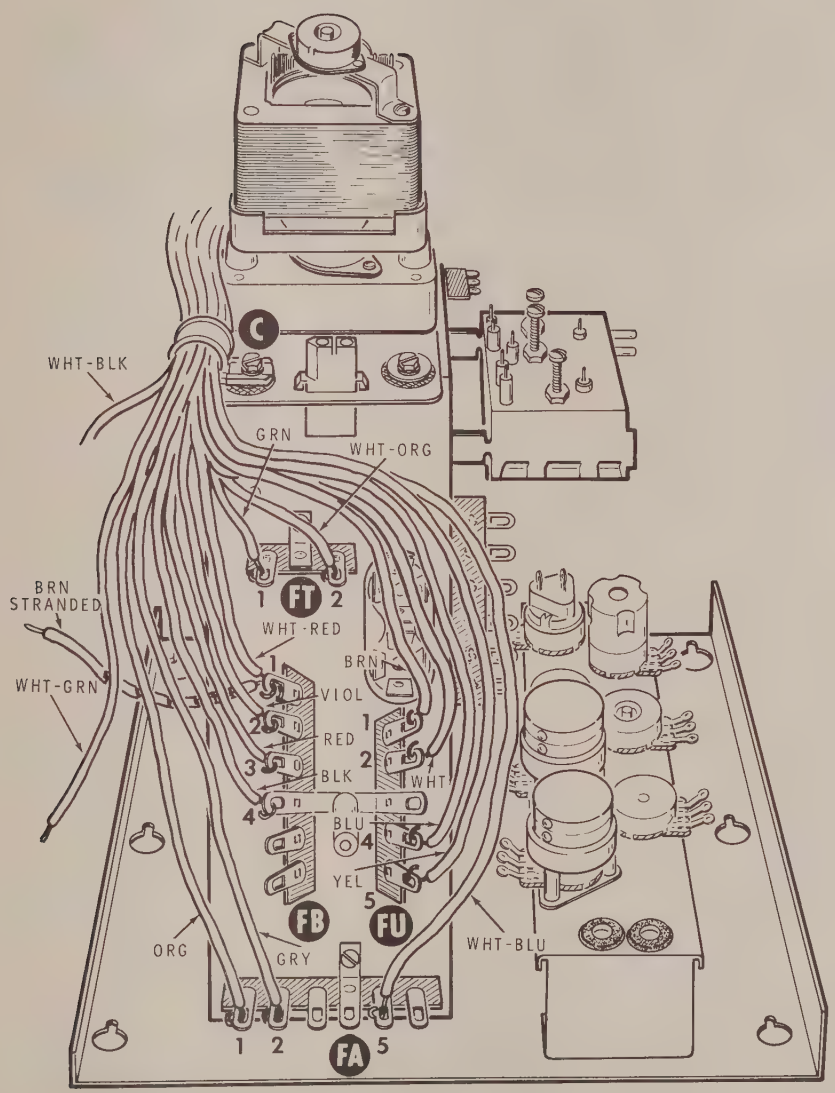
PICTORI


INSULATING PAPER
6-32 x 3/8" SCREW
#6 FIBER WASHER
B
A
BRONZE SCREWS
C
TUNER PANEL
CG
CH

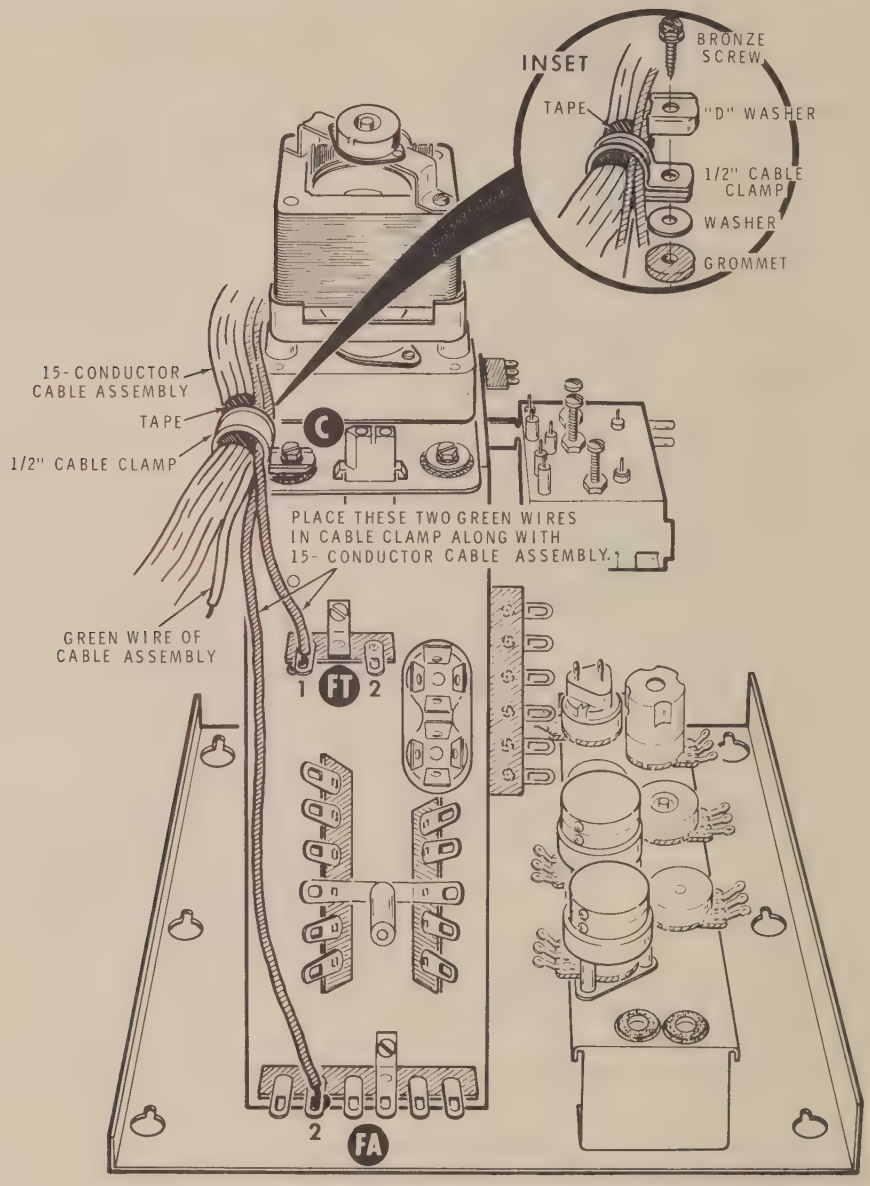
Detail 4-7A



PICTORIAL 4-10



PICTORIAL 4-8



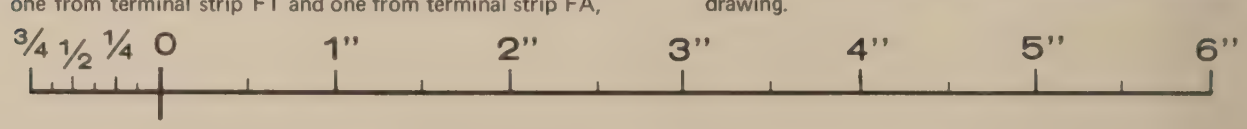
Detail 4-8A

Refer to Pictorial 4-8 (fold-out from Page 44) for the following steps.

( ) Locate the 15-conductor cable assembly supplied with this kit. Then coil up the white-black wire and wrap a rubber band around it to keep it out of the way.

NOTE: The two green wires that go to the motor switch, one from terminal strip FT and one from terminal strip FA, will be clamped to the back of the tuner panel in the next step along with the wires of the 15-conductor cable. The 15-conductor cable should be positioned so the tape around the cable is under the cable clamp.

( ) Refer to Detail 4-8A and remove the bronze screw and flat washer from the tuner panel at C. Then clamp the two indicated green wires and the 15-conductor cable assembly to the tuner panel at C as shown in the inset drawing.



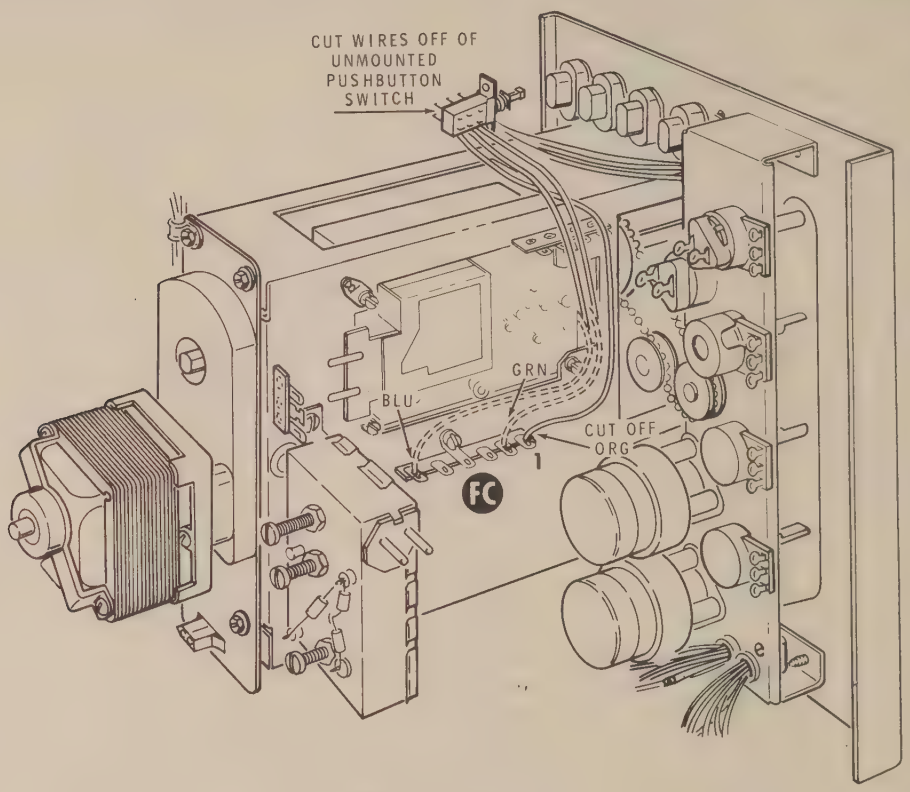
( ) Remove (strip) 1/8" of insulation from one end and 1/4" of insulation from the other end of a 7-1/2" brown stranded wire. Apply a small amount of solder to both ends to hold the fine strands together.

( ) Connect the 1/4" stripped end of this brown wire to lug 1 of terminal strip FB (NS). The other end will be connected later.

Connect the wires of the 15-conductor cable as directed in the following chart. Position each wire as shown in the Pictorial.

WIRE COLOR	CONNECT TO	TOTAL NUMBER OF WIRES ON TERMINAL STRIP LUG
( ) Green	Lug 1 of terminal strip FT (S-4).	4
( ) White-orange	Lug 2 of terminal strip FT (S-2).	2
( ) White-red	Lug 1 of terminal strip FB (S-3).	3
( ) Violet	Lug 2 of terminal strip FB (S-3).	3
( ) Red	Lug 3 of terminal strip FB (S-3).	3
( ) Black	Lug 4 of terminal strip FB (S-1).	1
( ) Gray	Lug 2 of terminal strip FA (S-6).	6
( ) Orange	Lug 1 of terminal strip FA (S-3).	3
( ) Brown	Lug 1 of terminal strip FU (S-2).	2
( ) White	Lug 2 of terminal strip FU (S-2).	2
( ) Blue	Lug 4 of terminal strip FU (S-2).	2
( ) Yellow	Lug 5 of terminal strip FU (S-2).	2
( ) White-blue	Lug 5 of terminal strip FA (S-2).	2

NOTE: The white-green and white-black wires will be connected later.



PICTORIAL 4-9

Refer to Pictorial 4-9 for the following steps.

( ) Cut the wires off of the unmounted pushbutton switch. Cut the wires as close as possible to the lugs; then discard the switch and the black wire.

( ) Follow the orange wire down to lug 1 on terminal strip FC. Cut this orange wire off at lug 1 and discard it. CAUTION: Be sure you cut off the proper wire, as there are three orange wires connected to lug 1.

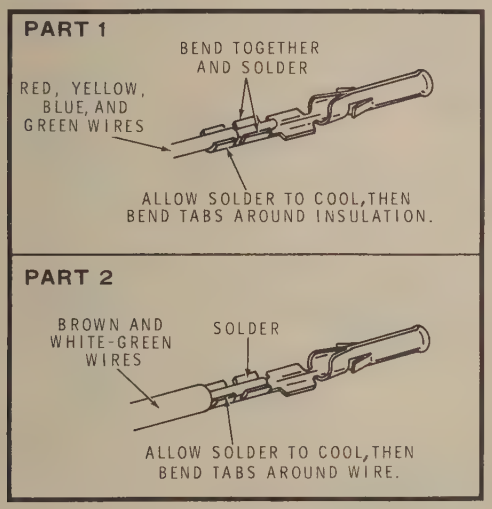
( ) Route the free ends of the disconnected blue and green wires through the opening in the tuner panel as shown by the dotted lines on the Pictorial; then toward the partially-wired circuit board connector assembly.

NOTE: The other ends of the disconnected red and yellow wires are soldered to the VHF and UHF panel lamps. These lamps are accessible through the opening in the tuner panel.

( ) From the panel lamp end, pull on the red and the yellow wires until their free ends are within the opening in the tuner panel.

( ) Route the free ends of the red and yellow wires toward the partially-wired circuit board connector assembly. Position each wire so it does not interfere with the bead chain and pulleys of the VHF fine tuning mechanism.

( ) Remove 1/8" of insulation from the ends of the red, yellow, blue, and green wires.


PART 1
BEND TOGETHER AND SOLDER
RED, YELLOW, BLUE, AND GREEN WIRES
ALLOW SOLDER TO COOL, THEN BEND TABS AROUND INSULATION.
PART 2
BROWN AND WHITE-GREEN WIRES
SOLDER
ALLOW SOLDER TO COOL, THEN BEND TABS AROUND WIRE.

Detail 4-10A

Refer to Pictorial 4-10 (fold-out from Page 44) for the following steps.

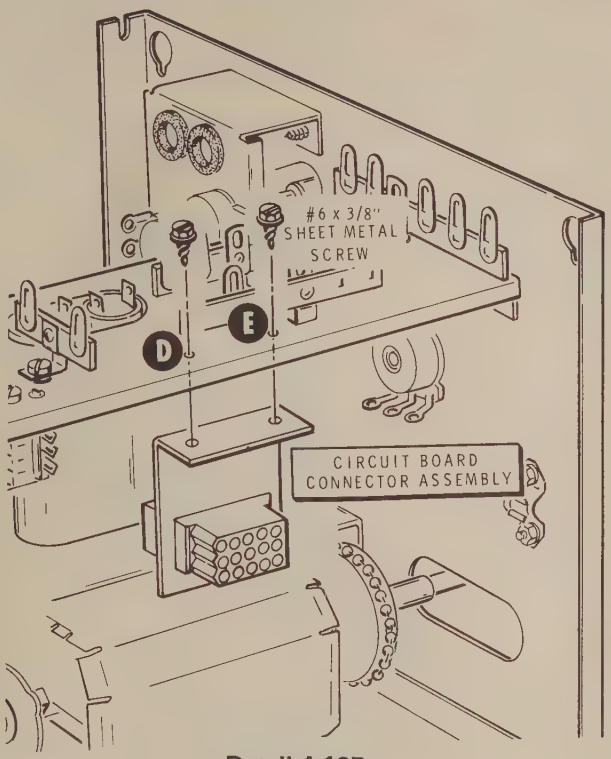
( ) Refer to Part 1 of Detail 4-10A and install connector pins (#432-73) on the free ends of the red, yellow, blue, and green wires.

( ) Cut the bared end of the white-green wire coming from the 15-conductor cable to 1/4".

( ) Refer to Part 2 of Detail 4-10A and install connector pins on the free ends of the white-green and the brown stranded wires.

( ) Refer to Detail 4-10B and remove and save the #6 x 3/8" sheet metal screws at D and E. Then carefully move the partially-wired circuit board connector assembly out of the open area within the tuner panel.

Refer to Pictorial 4-10 and insert the prepared wires into the holes in the partially-wired circuit board connector as follows. Push the connector pins on the wires into the indicated holes in the connector housing until they lock in place.

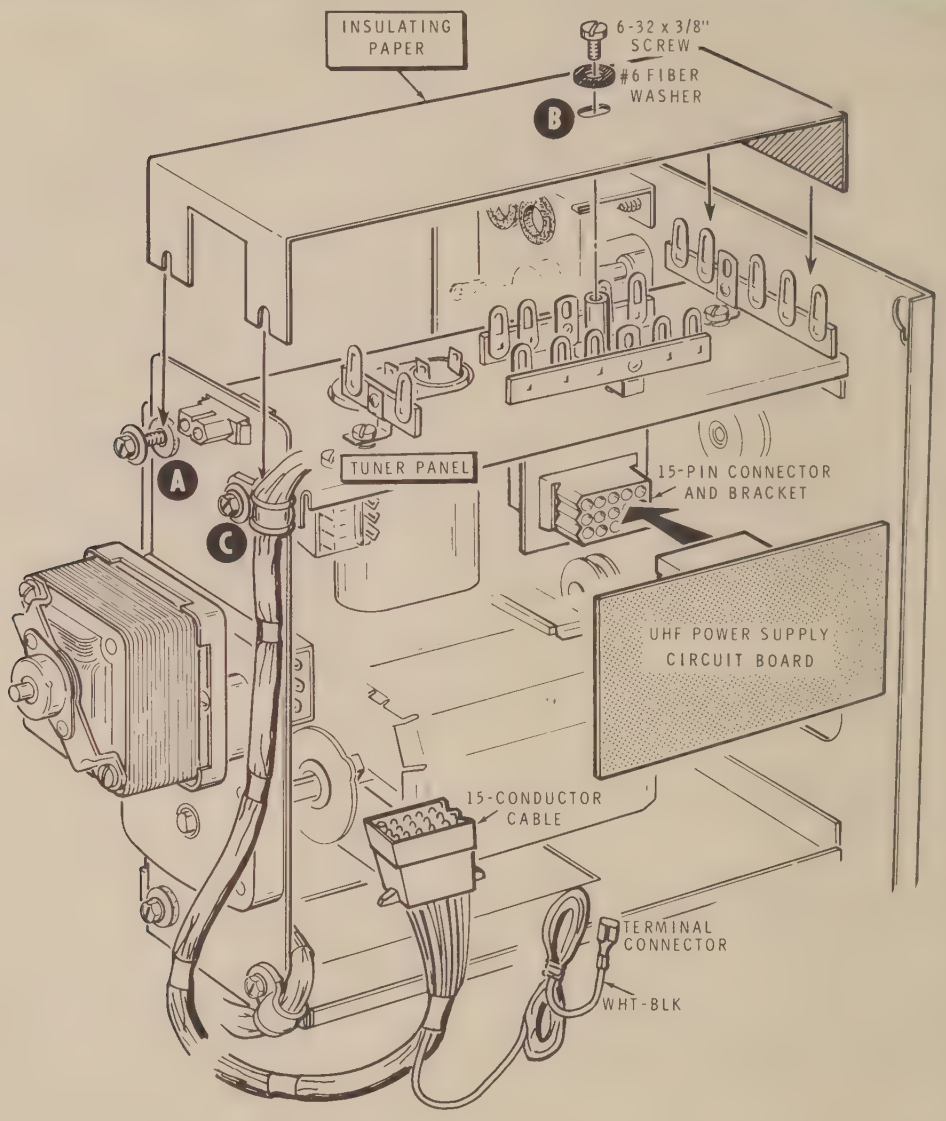


Detail 4-10B

WIRE COLOR	HOLE NUMBER
( ) Brown	13
( ) White-green	14
( ) Green	15
( ) Red	12
( ) Blue	9
( ) Yellow	6

NOTE: Hole #10 is not used.

( ) Refer to Detail 4-10B and reinstall the wired connector assembly in the open area of the tuner panel with the #6 x 3/8" sheet metal screws previously removed. Position the wires so they will not interfere with the operation of the VHF fine tuning mechanism.



PICTORIAL 4-11

Refer to Pictorial 4-11 for the following steps.

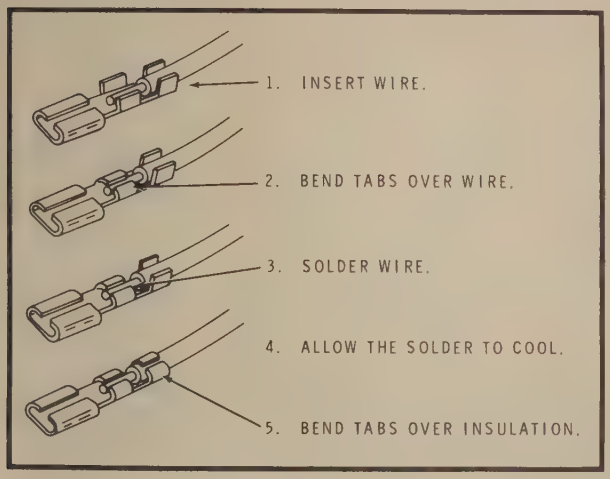
( ) Locate the UHF power supply circuit board and carefully plug it onto the 15-pin connector.

( ) Loosen the sheet metal screws at A and C and slide the insulating paper under the flat washers. Then tighten screws A and C.

( ) Position the insulating paper as shown and secure it at B with the #6 fiber washer and 6-32 x 3/8" screw previously removed.

( ) At the free end of the coiled-up, white-black wire of the 15-conductor cable, cut the bare wire to 1/8".

( ) Refer to Detail 4-11A and install a terminal connector on the free end of the coiled-up, white-black wire as shown.



Detail 4-11A

FRONT PANEL REASSEMBLY

Refer to Pictorial 5-1 for the following steps.

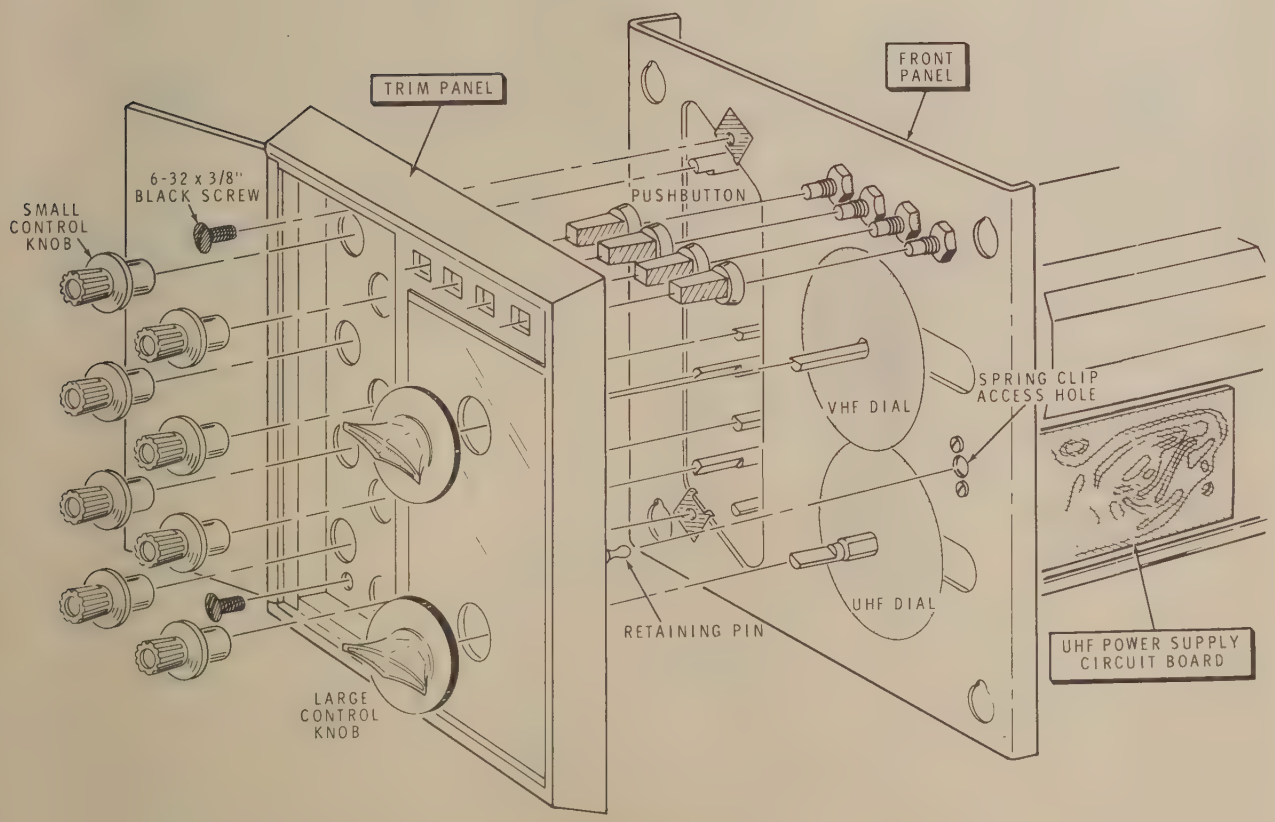
( ) Place the pushbuttons into the holes in the trim panel.

( ) Line up the trim panel with the pushbutton switches and control shafts, and insert the retainer pin on the inside of the trim panel into the spring clip access hole. Then press on the trim panel until the retainer pin snaps into the spring clip.

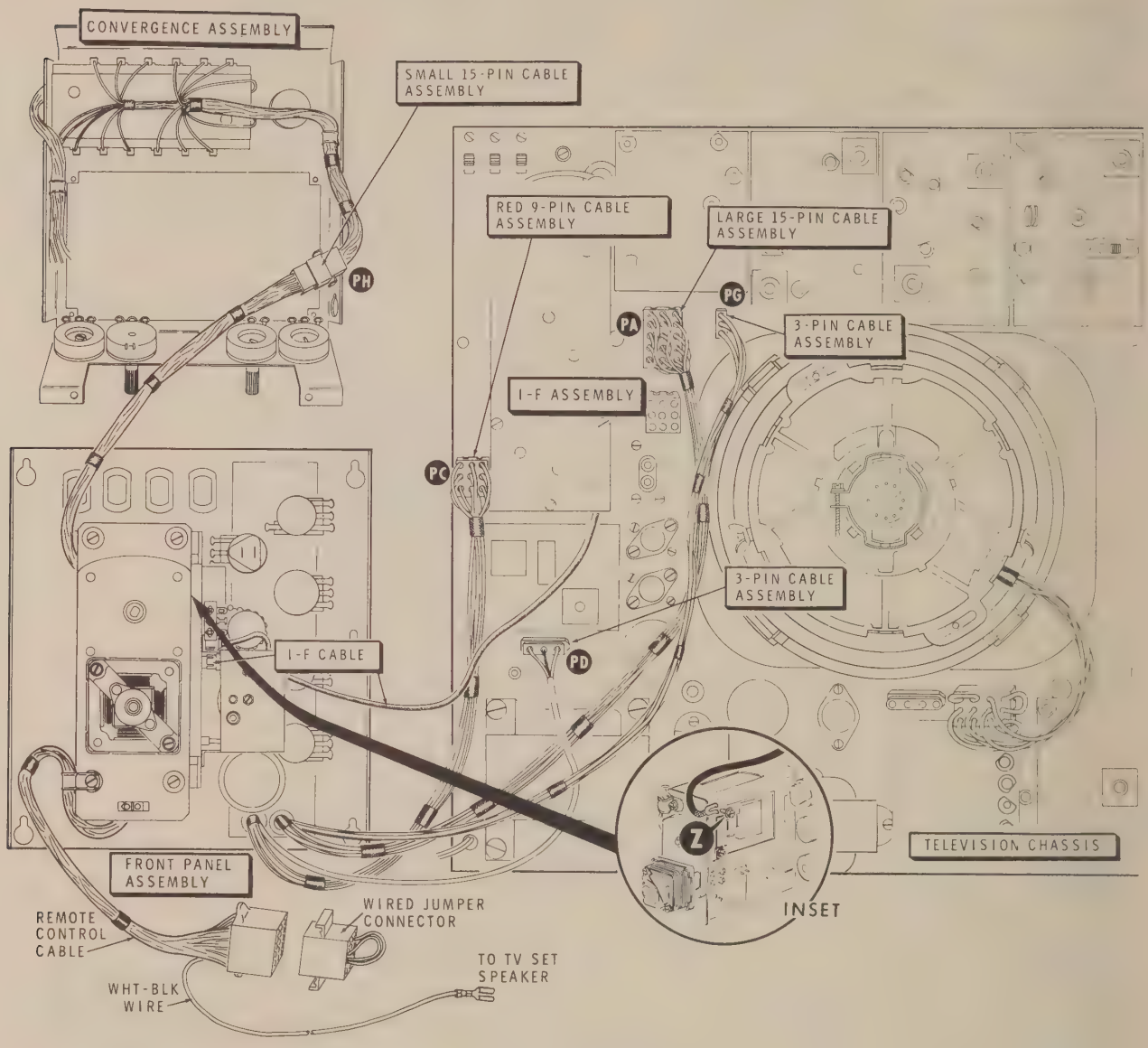
( ) Secure the trim panel to the front panel with the two 6-32 x 3/8" black screws previously removed.

( ) Install large control knobs on the Tuner shaft and on the Volume control shaft.

( ) Install the remaining eight small control knobs on the shafts of the controls located behind the control knob access door.



PICTORIAL 5-1



PICTORIAL 6-1

RECONNECTING FRONT PANEL ASSEMBLY

Refer to Pictorial 6-1 for the following steps.

NOTE: The cables that will be connected in the following seven steps were previously disconnected from the TV Set.

( ) Install the modified front panel assembly into the TV Set enclosure.

( ) Connect the 9-pin cable assembly (red cable plug PC) to TV chassis connector PC.

( ) Connect the large 15-pin cable assembly (cable plug PA) to TV chassis connector PA.

( ) Connect the 3-pin cable assembly (cable plug PD) to TV chassis connector PD.

( ) Connect the 3-pin cable assembly (cable plug PG) to TV chassis connector PG.

( ) Connect the small 15-pin cable assembly (cable plug PH) to Convergence Assembly cable socket PH.

( ) Connect the shielded i-f cable coming from the I-F Assembly on the TV chassis to the i-f output jack on the top of the VHF tuner in the front panel assembly.

( ) Refer to the inset drawing on the Pictorial and reconnect the ground lead under the screw at Z on the tuner panel.

This completes the cable connections between the Front Panel Assembly and the TV Set.

( ) Plug the wired jumper connector into the 15-pin connector on the end of the remote control cable. The white-black wire of the remote control cable will be connected later.

( ) Make sure all of the television set cables are properly connected. Then turn on the TV Set with the ON-OFF/BRIGHT control. Make sure the set operates properly before you perform the following steps.

CONNECTING REMOTE CONTROL RECEIVER

Refer to Pictorial 6-2 (fold-out from this page) for the following steps.

( ) Unplug the TV Set line cord plug from the wall outlet. Then unplug the wired jumper connector from the remote control cable. Save the jumper connector.

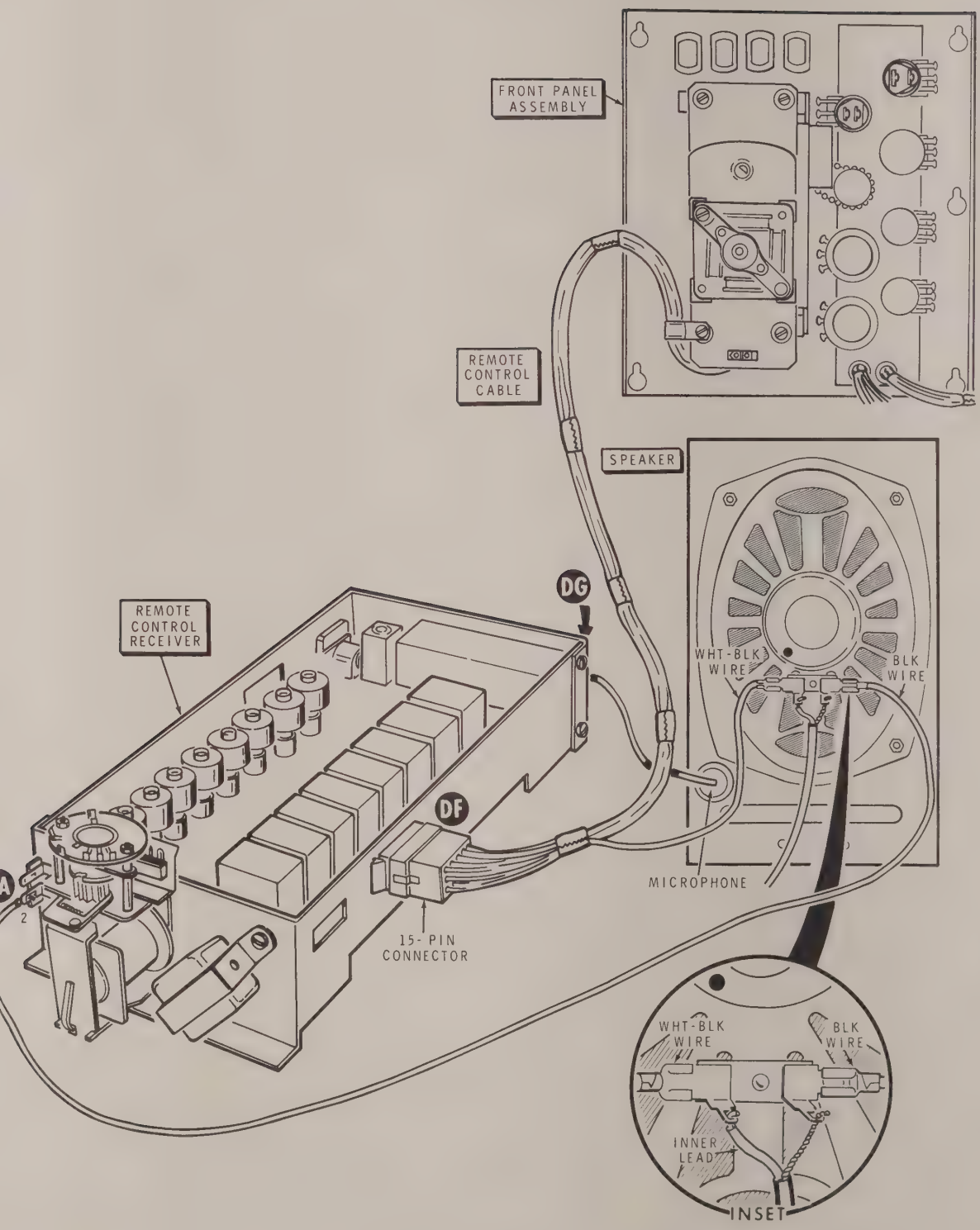
( ) Connect the remote control cable to connector DF on the Remote Control Receiver as shown. Then unwind the coiled up white-black wire of the remote control cable.

( ) Refer to the inset drawing on the Pictorial and connect the white-black wire to the speaker in the TV Set. Push the terminal connector onto the speaker lug to which the inner lead of the shielded speaker cable is connected.

( ) Push the terminal connector on the black wire coming from terminal strip DA, as shown, onto the speaker lug to which the shield lead of the speaker cable is connected.

( ) Plug the microphone cable into jack DG on the remote control receiver.

This completes the modification of the front panel assembly of your TV Set. Carefully inspect all the connections you have made to be sure there are no loose wires or poor solder connections. Be sure there are no solder bridges between foils on the UHF power supply circuit board. Remove any wire clippings that may have lodged in the wiring. Then proceed to the "Receiver Adjustments."



PICTORIAL 6-2

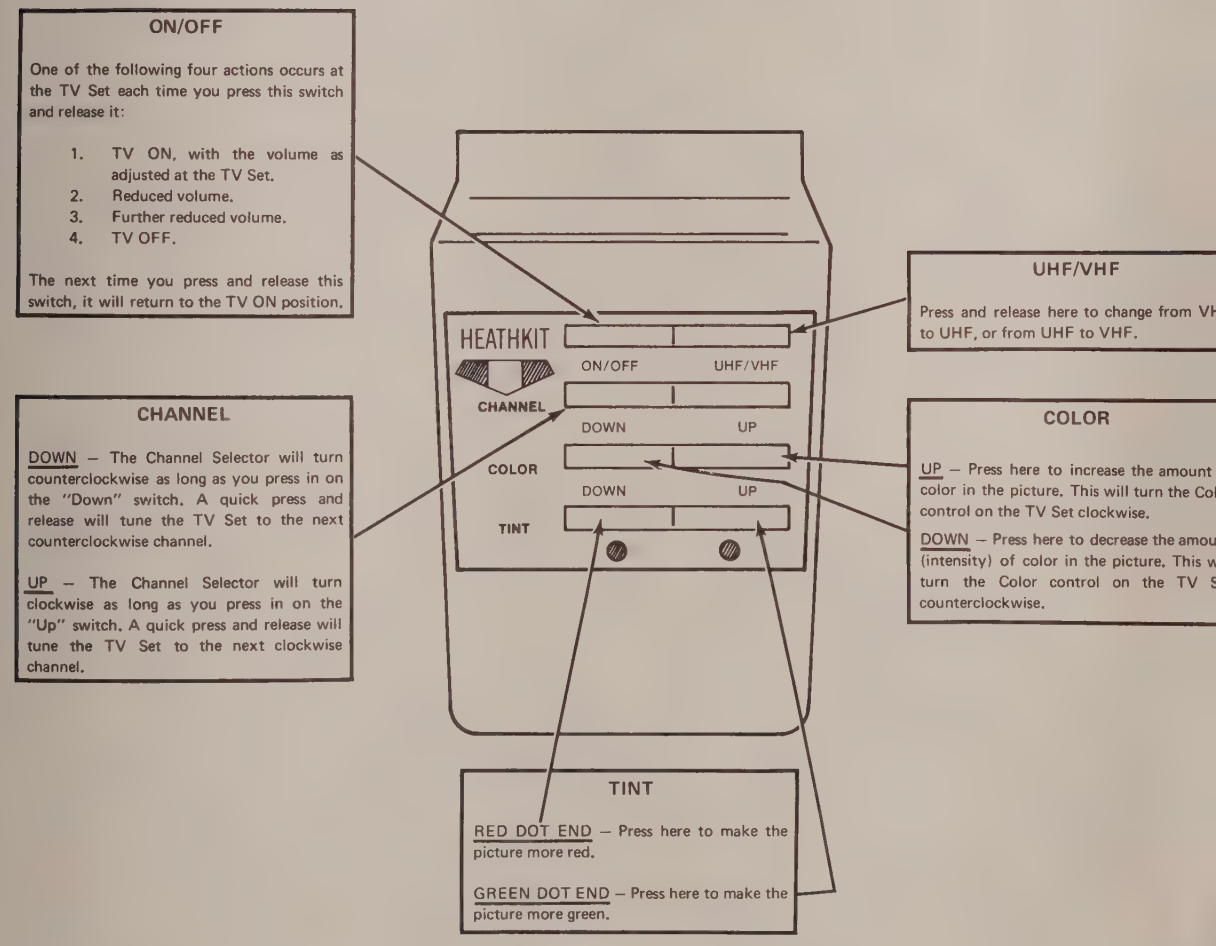
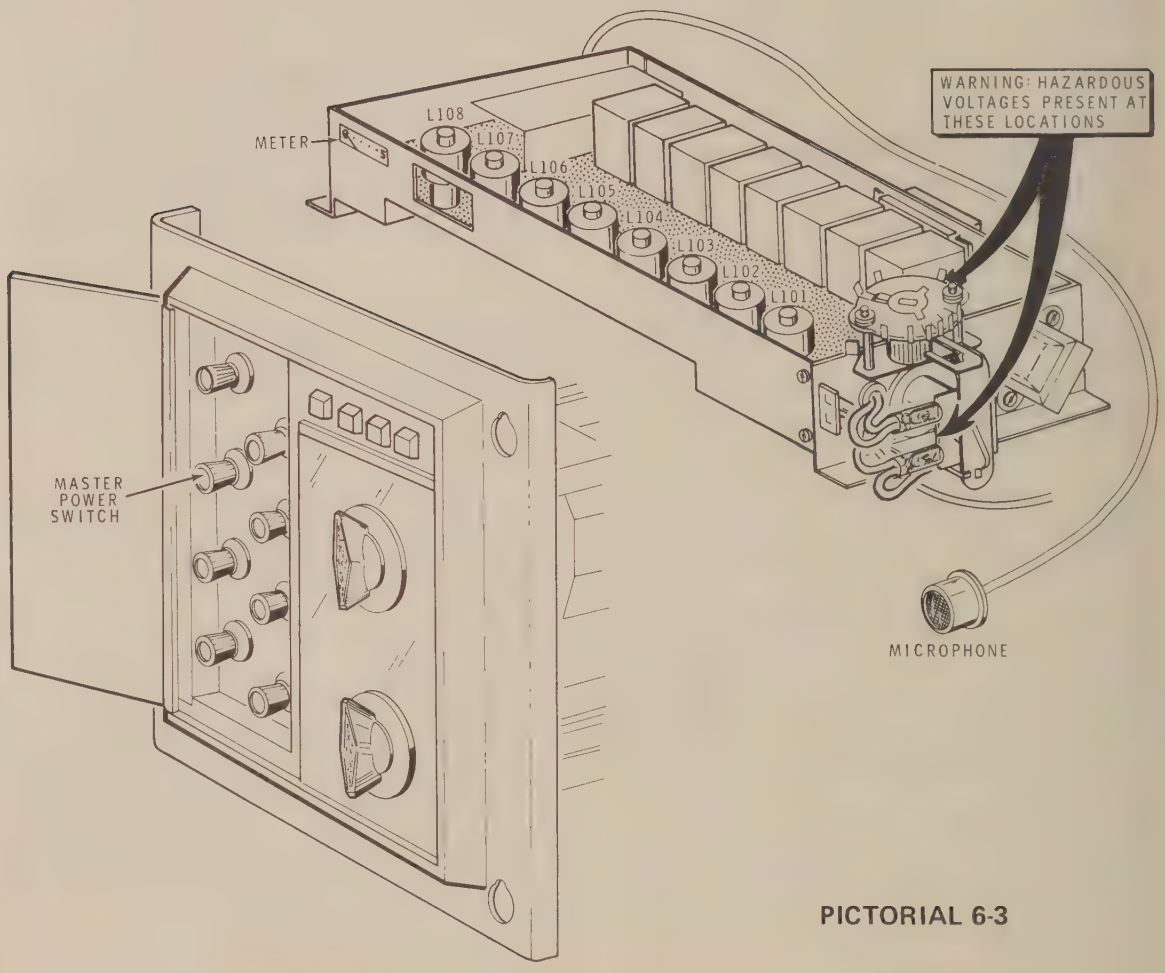

ON/OFF
One of the following four actions occurs at the TV Set each time you press this switch and release it:
1. TV ON, with the volume as adjusted at the TV Set.
2. Reduced volume.
3. Further reduced volume.
4. TV OFF.
The next time you press and release this switch, it will return to the TV ON position.
CHANNEL
DOWN – The Channel Selector will turn counterclockwise as long as you press in on the "Down" switch. A quick press and release will tune the TV Set to the next counterclockwise channel.
UP – The Channel Selector will turn clockwise as long as you press in on the "Up" switch. A quick press and release will tune the TV Set to the next clockwise channel.
HEATHKIT
ON/OFF
UHF/VHF
CHANNEL
DOWN
UP
COLOR
DOWN
UP
TINT
UHF/VHF
Press and release here to change from VH to UHF, or from UHF to VHF.
COLOR
UP – Press here to increase the amount color in the picture. This will turn the Col control on the TV Set clockwise.
DOWN – Press here to decrease the amou (intensity) of color in the picture. This w turn the Color control on the TV S counterclockwise.
TINT
RED DOT END – Press here to make the picture more red.
GREEN DOT END – Press here to make the picture more green.

FIGURE 1

RECEIVER ADJUSTMENTS



PICTORIAL 6-3

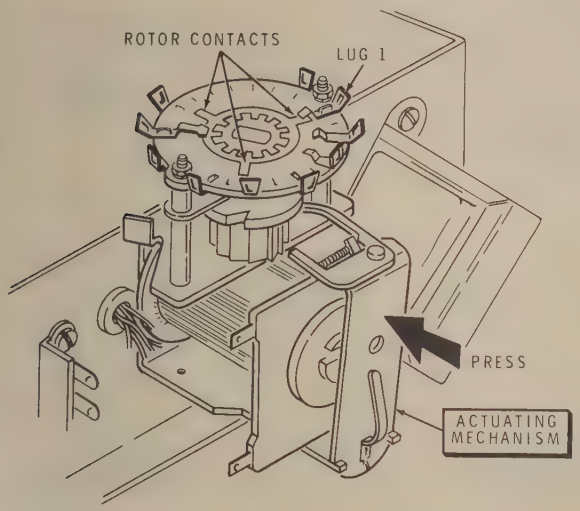
Refer to Pictorial 6-3 for the following steps.

( ) Be sure the TV Set line cord is unplugged from the wall outlet.

( ) Place a soft cloth on the TV Set. Then place the Remote Control Receiver on top of the set.

( ) Place the microphone next to the Receiver. The microphone should point toward you as you view the TV Set from the front.

( ) Refer to Detail 6-3A and push on the actuating mechanism with your finger until one of the three contacts on the switch rotor makes connection with lug 1. When the switch rotor is in this position, the ac portion of the TV Set is off. There is, however, dc voltage on some of the switch contacts.



Detail 6-3A

CAUTION: When the TV Set is plugged in and the master power switch turned on, ac voltage will be present at the switch contacts of the stepping relay. When the TV Set is operating (turned on by the Remote Control transmitter) dc voltage will be present at the wafer switch contacts on the stepping relay.

( ) Plug the TV Set line cord into an ac outlet. Then turn on the master power switch (marked ON/OFF-BRIGHT).

NOTE: The TV Set will still not operate. This is because the stepping relay switch on the Remote Control receiver is in its off position. However, power is now applied to the Remote Control receiver. When the master power switch on the TV Set is turned off, no power will be applied to the Remote Control receiver or to the TV Set.

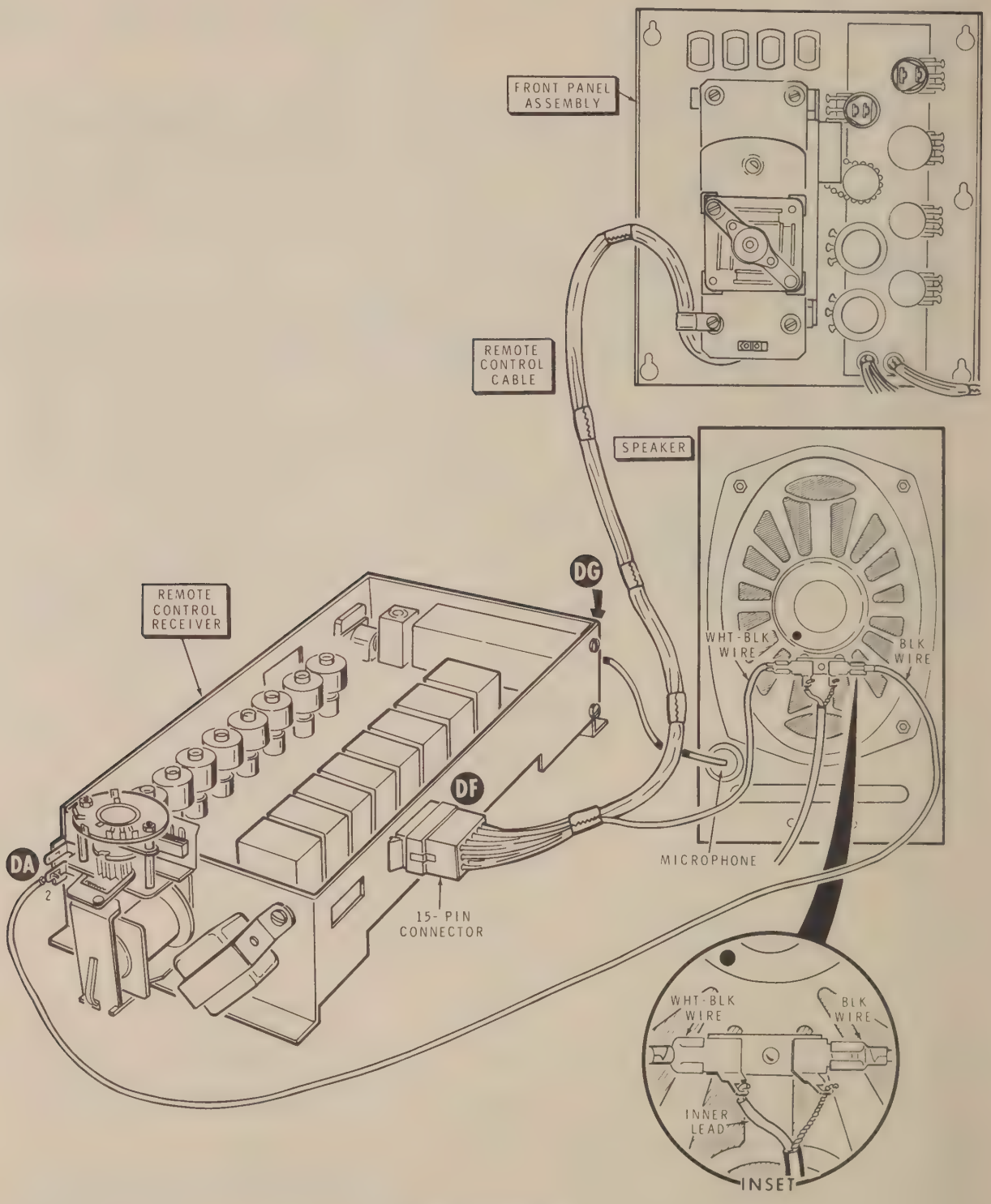
When you make the following adjustments, hold the transmitter approximately 2 feet in front of and in line with the microphone. Then press and hold down each transmitter rocker switch in the order listed in the following chart. Adjust the slug in the indicated coil with the plastic alignment tool while you observe the reading of the signal meter. If the proper result is not obtained for each step, refer to the "In Case of Difficulty" section on Page 63 of this Manual. After the trouble has been located and corrected, continue with the Adjustments.

( ) Use the plastic alignment tool to preset the slugs in the receiver coils so the top of each slug is even with the top of the coil form. Then perform the steps in the following "Adjustment Chart" in the order listed.

ADJUSTMENT CHART

TRANSMITTER SWITCH	RECEIVER COIL (Adjust Clockwise)	METER READING
( ) TINT (Green)	L108	Maximum
( ) TINT (Red)	L107	Maximum
( ) COLOR (Up)	L106	Maximum
( ) COLOR (Down)	L105	Maximum
( ) CHANNEL (Up)	L104	Maximum
( ) CHANNEL (Down)	L103	Maximum
( ) UHF/VHF	L102	Maximum
( ) ON/OFF (and Volume)	L101	Maximum

( ) Turn off the master power switch (ON/OFF-BRIGHT) on the TV Set. This completes the "Receiver Adjustments".

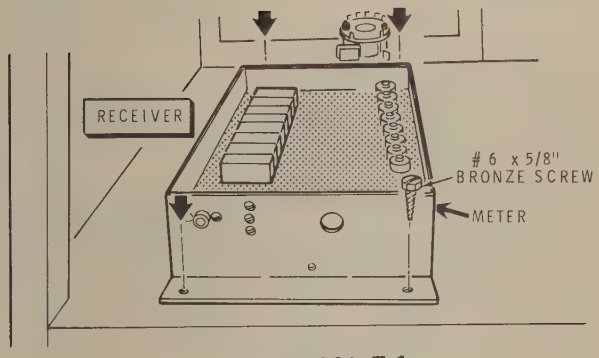


PICTORIAL 6-2
(Repeat)

RECEIVER INSTALLATION

Two sets of insturctions follow: "Custom Installations" and "Heathkit TV Cabinet Installations" (Page 56). Refer to the one that will apply to your TV Set.

CUSTOM INSTALLATIONS



PICTORIAL 7-1

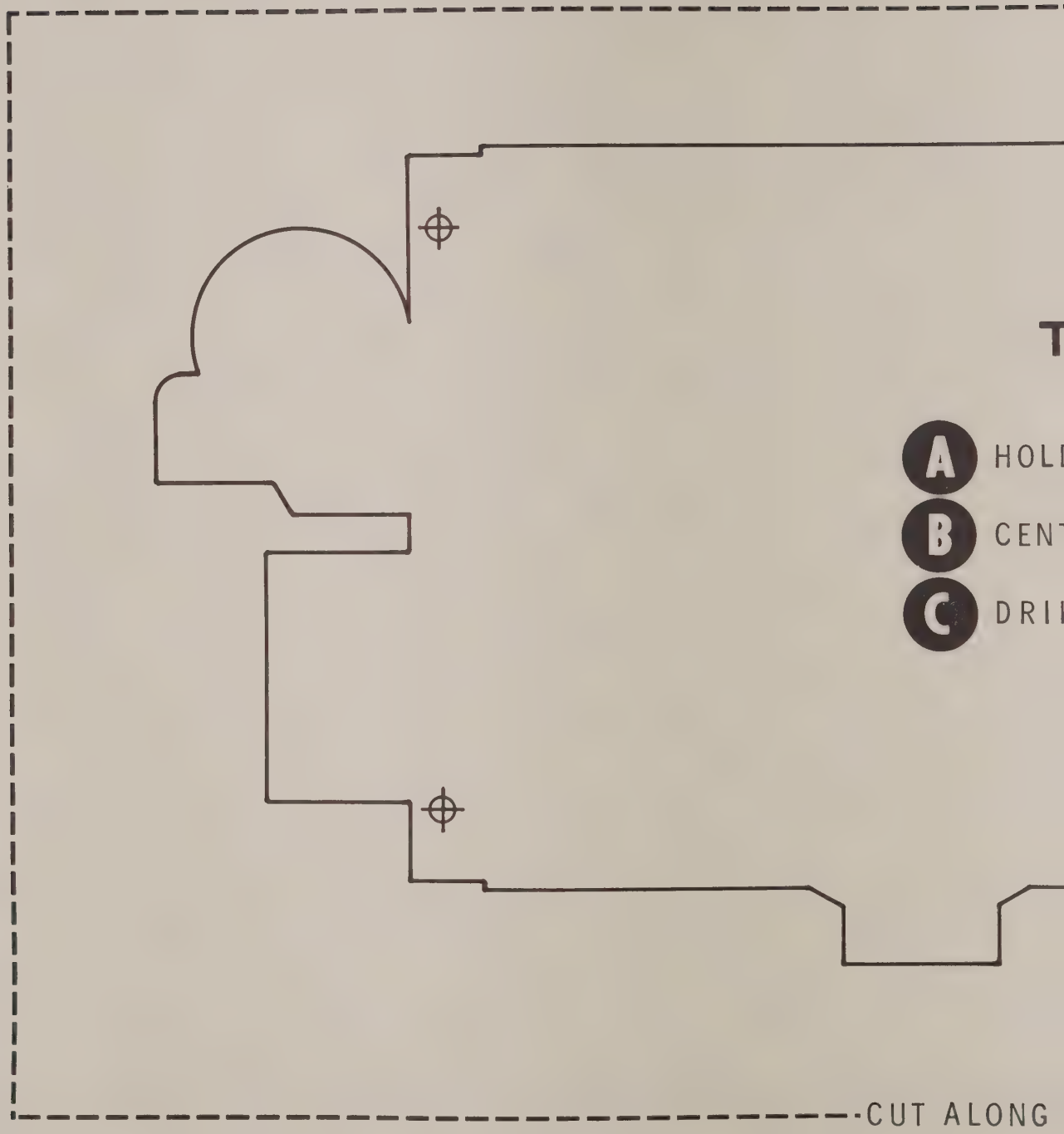
The Remote Control receiver can be mounted in any position, with the preferred location being a flat surface inside the TV cabinet as shown in Pictorial 7-1. A mounting template is provided on the fold-out from Page 55. Follow the directions printed on the template for proper mounting hole location. Keep in mind the following requirements when you install the receiver and microphone.

1. Mount the Remote Control receiver so that, when the microphone is installed on the enclosure panel or in the wall, the microphone cable will reach to the jack on the receiver chassis.

2. Position the receiver so its meter dial is visible.

3. Make a 15/16" hole in the enclosure panel or wall to mount the microphone.

CAUTION: If you mount the Receiver on some surface other than the bottom of the cabinet, as shown in Pictorial 7-1, be sure you do not drill through the mounting surface. Also, use shorter mounting screws that will not go through the mounting surface or panel. Refer also to any mounting instructions in the assembly manual for your TV Set.


T
A HOL
B CEN
C DRI
CUT ALONG

TEMPLATE

D TEMPLATE IN PLACE.

TER PUNCH FOUR HOLES.

LL HOLES WITH 3/32" DRILL.

DOTTED LINE

HEATHKIT TV CABINET INSTALLATIONS

Use the following instructions to install the Remote Control receiver in a Heathkit TV Cabinet. Perform the steps that correspond with the TV Model you purchased.

MODEL GR-900

Refer to Pictorial 7-2 for the following steps.

NOTE: The Remote Control receiver can be mounted in any position, but the preferred location is on a flat surface inside the TV cabinet as shown in the Pictorial. It may be easier to mount the receiver if the cables and wires are disconnected from the receiver.

( ) Cut out the mounting template (fold-out from Page 55). Then follow the directions on the template and mark and prepare the mounting location.

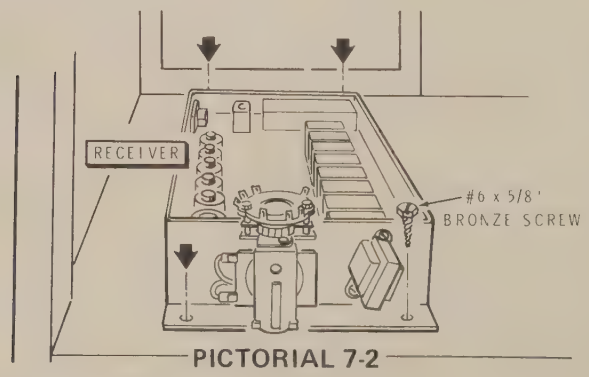
( ) Mount the receiver with four #6 x 5/8" bronze screws at the indicated locations.

NOTE: A microphone mounting hole is provided in the speaker panel in all Heathkit TV cabinets.

( ) Carefully press the microphone into its mounting hole in the speaker panel. (See Pictorial 6-2 on Page 54). Also, if you disconnected the microphone cable, plug it into the microphone jack on the receiver chassis.

( ) Reconnect the 15-pin connector on the remote control cable to the Receiver.

This completes the "Receiver Installation". Now perform the steps in the following "Final Checkout" section.



PICTORIAL 7-2

MODEL GR-271

Refer to Pictorial 7-3 for the following steps.

In the following steps the Remote Control receiver will be mounted on the side of the picture tube shield. It may be easier to install the receiver if you disconnect the 15-pin connector cable and the cable leading to the microphone.

( ) Check the side of the picture tube shield. If a tab protrudes from the surface where the receiver will be mounted, bend the tab in toward the picture tube.

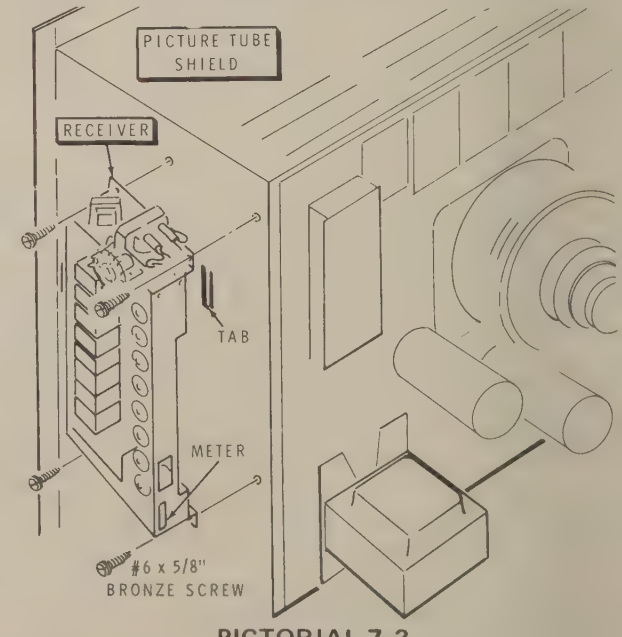
( ) Fasten the Remote Control receiver to the picture tube shield as shown. Use the four #6 x 5/8" bronze screws supplied with this kit. The actuating mechanism should be up and the meter dial visible from the back of the cabinet.

NOTE: A microphone mounting hole is provided in the speaker panel in all Heathkit TV cabinets.

( ) Carefully press the microphone into its mounting hole in the speaker panel. If the microphone cable is disconnected, plug it into the mocrophone jack on the receiver chassis.

( ) Reconnect the 15-pin connector on the remote control cable to the Receiver.

This completes the receiver installation. Now perform the steps in the following "Final Checkout" section.



PICTORIAL 7-3

NORMAL OPERATING CONDITIONS

This section of the Manual will cover certain operating characteristics of the Remote Control which are normal, but may appear as problems to the operator.

REFLECTIONS

The Remote Control transmitter is capable of sending one main signal for each function. When the transmitter is pointing directly at the microphone in the TV Set, it will perform the function properly. However, if the transmitter is not pointed correctly, the main signal can be reflected from the floor, walls, ceiling, or other objects in the room. These reflected signals could temporarily cancel out the main signal causing intermittent operation of that function. However, rugs and draperies will reduce these reflected signals considerably. The operating distance of the Remote Control is also affected by the reflected signals.

On-Off Function Switch

The proper way to operate this switch to obtain the OFF, ON, reduced volume, and further reduced volume positions is to press and release the switch quickly. It only takes a short pulse to actuate the switch to the next position. If the switch is held down too long, a reflected signal could cancel out the main signal temporarily and cause it to be, in effect, turned on and off. This would actuate the relay another step without your having pressed and released the ON-OFF switch a second time.

HORIZONTAL FREQUENCY HARMONICS

The frequencies used in this Remote Control (34 kHz to 44 kHz) are between the second and third harmonics of the TV Set's horizontal oscillator frequency. If the horizontal hold control is turned too far clockwise or counterclockwise, one or more of the Remote Control functions could be actuated. However, if this happened, the picture would be out of horizontal synchronization and could not be viewed until the horizontal hold control was adjusted properly.

FINAL CHECKOUT

Each function of the transmitter switches will be checked in the following steps. Stand approximately 5-feet in front of the TV Set with the transmitter pointed toward the set when you perform these checks.

ON/OFF

The top rocker arm (ON/OFF side) on the transmitter performs four functions in the following sequence. Each time you press this switch, the stepping relay on the receiver turns the switch rotor one position, or step, to a new function.

1. TV OFF.
2. TV ON (The volume will be determined by the setting of the Volume control on the TV Set).
3. Reduced volume.
4. Further reduced volume.

( ) Since the stepping relay could be in any one of these positions, press and release the ON/OFF end of the rocker switch until the TV Set is turned off.

Now refer to the following steps and check each of the four functions by pressing the ON/OFF end of this rocker arm.

( ) First press: TV on. NOTE: Adjust the TV Volume control for the desired volume.

( ) Second press: Reduced volume.

( ) Third press: Further reduction of volume.

( ) Fourth press: TV off.

Continued pressing of the ON/OFF end of this rocker arm will result in repeating the above four functions. NOTE: The stepping relay in the receiver should only operate when the ON/OFF end of this one rocker arm is pressed.

UHF/VHF

The UHF/VHF switching function is performed by an electronic switch on the UHF Power Supply circuit board. The TV Set will remain in the same operating mode (UHF or VHF) and tuned to the same station when it is turned off and then back on by the Remote Control Transmitter. A change in operating mode may occur if the TV Set is turned off and then back on by the ON-OFF/BRIGHT control (master power switch), or if the line cord has been removed from the power outlet and then plugged back in again.

NOTE: There are two lamps in the front panel assembly. One lights during VHF operation and the other during UHF operation.

( ) Press the UHF/VHF end of the rocker arm until only the VHF panel lamp lights. The desired VHF station can now be selected by turning the channel selector knob.

( ) Press the UHF/VHF end of the rocker arm once more. Now only the UHF panel lamp should light. The desired UHF station can now be selected by turning the channel selector knob.

CHANNEL

NOTE: Pressing the transmitter CHANNEL rocker arm will select the desired VHF or UHF channel.

( ) Observe the number of the channel being received. Then press and release the DOWN end of the Transmitter CHANNEL rocker arm. The tuner should turn to the next lower channel.

( ) Press and hold the DOWN end of the rocker arm. The tuner should continue to rotate in a high-to-low channel direction until the rocker arm is released.

( ) Again observe the number of the channel being received. Then press and release the UP end of the CHANNEL rocker arm. The tuner should turn to the next higher channel.

( ) Press and hold the UP end of the rocker arm. The tuner should continue to rotate in a low-to-high channel direction until the rocker arm is released.

NOTE: The motors on the rear of the TV Set Color and Tint controls referred to in the following steps have built-in clutches that allow the motors to run even though the controls have reached the end of their rotation.

COLOR

( ) Press the UP end of the transmitter COLOR rocker arm. Hold the arm until the TV Color control has rotated to its maximum (fully clockwise) color position; then release the rocker arm.

( ) Press the DOWN end of the COLOR rocker arm. Again hold the arm until the TV color control has rotated to its minimum (fully counterclockwise) color position; then release the rocker arm.

( ) Now press the COLOR rocker arm as necessary to adjust the color control for a normal picture.

TINT

Note the color dots below the TINT rocker arm. When the "green-dot end" of this rocker arm is pressed, the green color in the TV picture will increase and the red will decrease. When the "red-dot end" is pressed, the red color will increase in the TV picture and the green will decrease.

( ) Press the "green-dot" end of the Transmitter TINT rocker arm. Hold the arm until the TV Set Tint control has rotated to its fully clockwise (maximum green) position.

( ) Press the "red-dot" end of the TINT rocker arm. Hold the arm until the TV Set Tint control has rotated to its fully counterclockwise (maximum red) position.

( ) Now press the TINT rocker arm as necessary to adjust the Tint control for a normal picture.

Push and release the ON/OFF end of the top rocker arm until the TV Set is turned off.

This completes the "Final Checkout" procedure.

OPERATION

Refer to Figure 1 (fold-out from Page 52) for a description of the control functions available at each rocker arm. Also refer to the information that follows.

OPERATING DISTANCE

The transmitter should be used in the same room in which the TV Set is located. In exceptionally large areas, the transmitter should normally be used not further than twenty feet away from the front of the TV Set.

TV SET OPERATION WITHOUT REMOTE CONTROL

You can manually operate your TV Set at any time with its front panel controls even though the Remote Control is installed. This will not damage either the Remote Control or the TV Set.

If a problem should develop in the receiver of the Remote Control, you can operate your TV Set while the receiver is being serviced. Locate the wired jumper connector supplied with the Remote Control. Then perform the following steps.

1. Turn the ON/OFF-BRIGHT control (master power switch) on the TV Set to the OFF position.

2. Unplug the 15-conductor remote control cable from the Remote Control receiver. Then disconnect the black wire that goes from the receiver to the TV Set speaker.

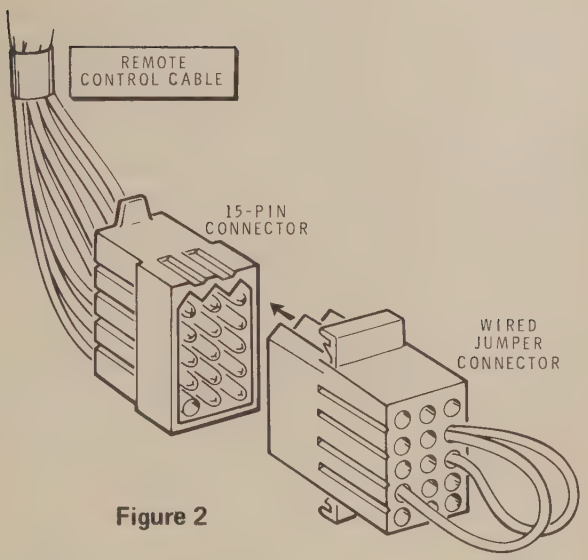


Figure 2

3. Refer to Figure 2 and plug the wired jumper connector into the 15-pin connector on the end of the remote control cable. This plug will bypass the switching functions of the Remote Control receiver and supply ac power to the TV Set. The set must now be turned on or off by the ON/OFF-BRIGHT control (master power switch). The pushbutton ON-OFF switch at the top of the trim panel (instant on-off switch) is now inoperative.

4. After the Remote Control receiver has been serviced and is back in operation in the TV Set, place the wired jumper connector in a safe place for future use.

IN CASE OF DIFFICULTY

If your Remote Control (Transmitter or Receiver) does not operate properly after assembly, the following information will help you locate and correct the difficulty.

This part of the Manual includes the following three sections: "Finding the Area of Trouble," "General Tests," and a "Troubleshooting Chart." Refer to 'Finding the Area of Trouble" first. After you determine the area of the trouble, refer to the "General Tests" and the "Troubleshooting Chart" to pinpoint and correct the difficulty. Also available, in case you should need them, are sections titled "Factory Repair Service" and "Replacement Parts and Price Information."

When necessary, refer to other parts of the Manual. For example, you may wish to refer to the Block Diagram, "Identification Photographs," "Circuit Board X-Ray Views," and parts of the "Step-by-Step Assembly" section for help in locating parts and wires. If you have a knowledge of electronics, you will also find additional valuable information in the "Circuit Description" and Schematic diagram. All voltages listed on the Schematic diagram were taken with a high input impedance voltmeter.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover.

FINDING THE AREA OF TROUBLE

The first step in locating your difficulty is to determine whether it is in the transmitter or receiver. Begin, as directed below, by making sure the problem is not with the 9-volt battery. Then refer to the checks that follow for the transmitter and receiver. Once the problem is narrowed down to one of these two areas, refer to the "General Tests" and "Troubleshooting Chart" to locate and repair the difficulty.

BATTERY

Before you suspect a piece of equipment, be sure that the battery is properly connected and has a sufficient charge to provide proper operation. Make sure that the battery connector is wired with the red wire to hole P and the black wire to hole N.

If the transmitter will activate the receiver when held near the receiver but not at a normal distance (15 to 20 feet), the battery charge is probably low and the battery should be replaced. The battery can also be checked with the Heathkit "Troubleshooter." To get an accurate check, however, the battery must be checked under load. That is, with the battery connected and with one of the transmitter buttons pressed down.

TRANSMITTER

With the battery connected, hold the transmitter transducer near your ear and press down on one of the buttons intermittently. You should hear a slight click in the transducer each time you press the button. If you hear the click, the transmitter is operating. If you do not hear the click, the transmitter is not operating properly; refer to the General Tests and Troubleshooting Charts.

RECEIVER

CAUTION: When the Remote Control receiver is connected to the TV Set, high voltage will be present at several points in the receiver and on the stepping relay contacts and switch wafer. Be sure the Master ON-OFF switch is turned on. Then use caution and perform the following checks.

1. If the receiver does not operate at all when the transmitter On-Off switch is pressed, push on the relay stepper and advance the stepping relay one position by hand. This should turn the TV Set on. If the set still does not turn on, check the wiring to the stepping relay.

2. Repeat the "Receiver Adjustments," as described on Pages 52 and 53. This should help you narrow down the difficulty to a smaller area of the receiver. Then refer to the "General Tests" and "Troubleshooting Chart" to locate and repair the difficulty.

GENERAL TESTS

The following paragraphs deal with the types of difficulties that may show up right after a kit is assembled. These difficulties are most likely to be caused by assembly errors or faulty soldering. These checks will help you locate any error of this type that might be made.

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the builder.

2. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure they are soldered as described in the "Soldering" section of the "Kit Builders Guide."

3. Check the values of the parts. Be sure the proper parts have been wired into each circuit as shown in the Pictorial Diagrams. It would be easy, for example, to install a 10 kΩ (brown-black-orange) resistor where a 100 kΩ (brown-black-yellow) resistor should have been installed.

4. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

5. Check for solder bridges between circuit board foils.

6. If, after careful checks, the trouble is still not located, check voltage readings with those shown on the Voltage Charts (fold-out from Page 80) and on the Schematic (fold-out from Page 81). These measurements can be made with the Heathkit Troubleshooter or a high input impedance voltmeter. Voltages may vary ±20%.

7. A review of the Circuit Description (Page 73) and Schematic diagram may also help you locate any difficulties. NOTE: Refer to the Circuit Board X-Ray Views on Page 78 to help locate parts.

TROUBLESHOOTING CHART

DIFFICULTY	POSSIBLE CAUSE
A click cannot be heard in the transmitter transducer when a switch is pressed.	1. Battery weak or not connected. 2. Loose connections on transmitter circuit board. 3. Transducer leads installed backward. 4. Contact springs not aligned properly with contact rivets in circuit board. 5. Rocker arm shaft bracket not positioned properly and rocker arm not hitting spring contacts properly. 6. Coil L1 installed backward. 7. Capacitor C1 shorted. 8. Transistor Q8 defective. 9. Transducer defective.
The TV Set does not turn on and stepping relay RL109 does not operate when the transmitter On/Off button is pressed. No meter indication.	1. Master On-Off switch on television set not turned on. 2. Wiring error or unsoldered connection on terminal strip FB on TV front panel assembly. 3. Coil L101 not adjusted properly. 4. Capacitor C101, C105, or C111, or coil L101 may be defective or poorly soldered. 5. Transformer T101 shorted or open. 6. Microphone not plugged in. 7. Integrated circuit Q101 or transistor Q102 defective or installed incorrectly. 8. Diode D101, D102 or C128 defective or installed backward.
A switch for one function is pressed and a different function is performed by the receiver.	1. Coils L101 through L108 adjusted to wrong frequency. 2. Switch contacts on transmitter circuit board not making proper contact. 3. Wires improperly connected to the individual motors.
A function is performed by the receiver without being triggered by the transmitter. Meter also shows reading.	1. Coil for that function misadjusted and tuned to harmonic of TV set horizontal sweep frequency. 2. C102 and C106 interchanged, causing oscillation. 3. Shorted detector transistor for that function. 4. Bias resistors R109 and R111 (for On-Off function) or respective bias resistors for other functions are wrong value or poorly soldered.
A given function does not operate and the meter does not give an indication. Transmitter operating properly.	1. Receiver coil for that function not adjusted properly. 2. Capacitor across relay for that function (C112 for On-Off function) open, shorted, or poorly soldered. 3. Collector or emitter lead of transistor for that function open or poorly soldered. (Q102 for On-Off function.) 4. Open relay coil for that function.
Switch for function is pressed and meter indicates full scale, but relay for that function does not operate.	1. 25 μF electrolytic capacitor (#25-145) across relay coil shorted.

DIFFICULTY	POSSIBLE CAUSE
The transmitter will turn the TV Set on at a distance but other functions will not operate unless the transmitter is close to the receiver.	1. Receiver coil for that function not adjusted for maximum meter reading. 2. Wires at lugs 7, 9, and 12 of wafer switch on stepping relay RL107 interchanged or poorly soldered.
The signal meter indicates a signal from the transmitter, the relay closes, but the operation is not performed.	1. Individual motor wired incorrectly. 2. R129 or C127 for color motor and R131 or C135 for tint motor defective or poorly soldered. 3. Relay contacts dirty or do not close properly.
The meter needle goes off scale to the right. None of the functions operate.	1. Resistor R112 open or wrong value.
All functions operate properly when the transmitter is near the receiver, but difficult to operate at any distance from the receiver.	1. Receiver coils not adjusted for maximum meter reading. 2. Wiring of wafer switch on stepping relay RL109 incorrect or poorly soldered. 3. Resistor R101 or R102 open. 4. Capacitor C107 or C109 open. 5. Microphone defective. 6. Transducer in transmitter defective. 7. Transmitter battery weak.

REPLACEMENT PARTS AND PRICE INFORMATION

To order a Replacement Part: Use the Parts Order Form furnished with this kit. If one is not available, see "Replacement Parts" inside the rear cover of the Manual.

The prices in the Parts Lists apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from a Heathkit Electronic Center to cover local sales tax, postage, and handling. Outside the U.S.A., parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties and rates of exchange.

ALIGNMENT WITH INSTRUMENTS

The transmitter oscillator coil comes preset from the factory. However, this "Alignment with Instruments" section is furnished in case the transmitter should have to be aligned at some future time.

Refer to Figure 3 for the following steps.

To align the transmitter, you will need an oscilloscope and a signal generator capable of producing a 17 to 22 kHz signal.

( ) Open the transmitter case so that coil L1 can be reached.

( ) Set the signal generator to 22 kHz.

( ) Connect the output cable from the generator to the horizontal input of the oscilloscope.

( ) Adjust the output of the generator for a 2" horizontal trace on the oscilloscope screen.

( ) Connect the oscilloscope cable to the vertical input jack. Then place the probe 1" from the front of the transmitter as shown.

( ) Press the DOWN end of the Channel rocker arm and adjust the oscilloscope for a 2" vertical trace.

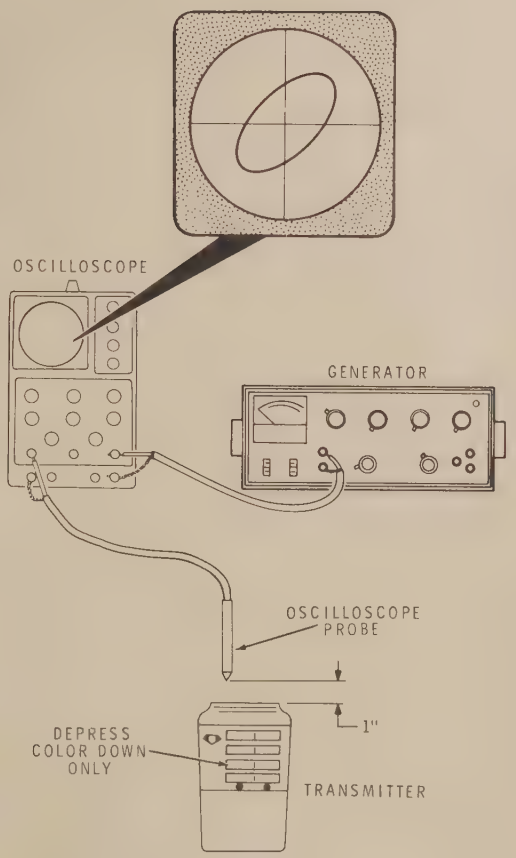


Figure 3

NOTE: When making the following adjustment, do not turn the coil slug more than 1/2 turn clockwise or counterclockwise from its present position.

( ) Press the DOWN end of the Channel rocker arm. Then use the plastic alignment tool to adjust the slug in oscillator coil L1 for an oscilloscope pattern as shown in Figure 3. CAUTION: Be sure you do not touch the transmitter circuit board with your hand, and that the circuit board does not touch any metal object.

This completes the transmitter alignment. Now readjust the receiver coils as instructed in the "Receiver Adjustments" (Page 52).

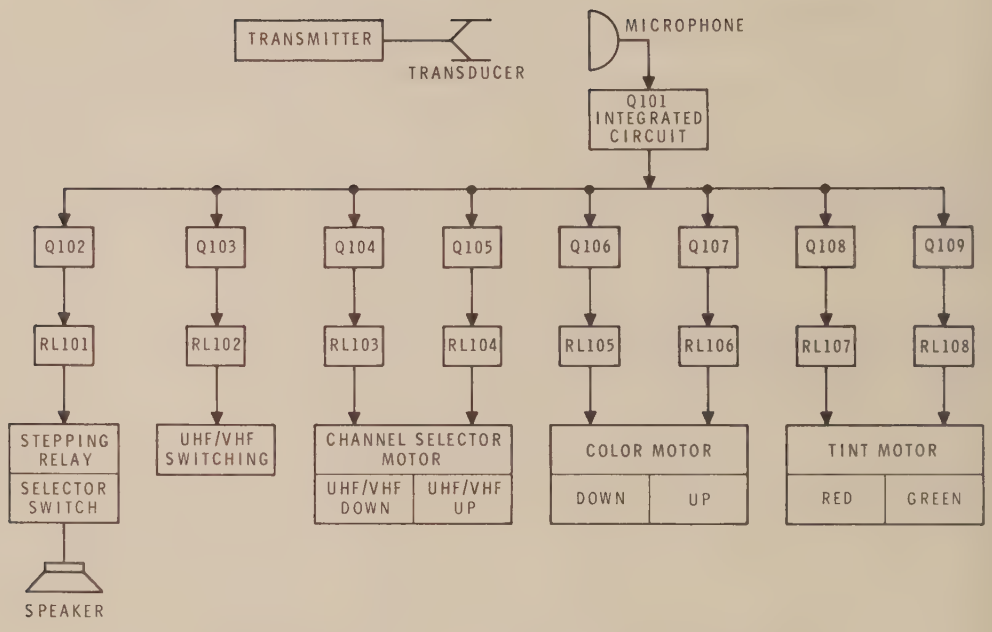
SPECIFICATIONS

Transmitter Switch Functions	On-Off (and Volume), UHF/VHF, Channel Selector (Up or Down), Color (Up or Down), Tint (Red or Green).
Receiver Channel Frequencies	On-Off: 42.50 kHz. UHF-VHF: 39.00 kHz. Channel Down: 44.00 kHz. Channel Up: 41.50 kHz. Color Down: 40.00 kHz. Color Up: 37.50 kHz. Tint Red: 34.25 kHz. Tint Green: 36.00 kHz.
Semiconductor Complement	
Transmitter	1 – 2N3393 transistor.
Receiver	8 – 2N3393 transistors. 1 – CA3035V1 integrated circuit. 3 – 1N2071 diodes. 1 – VR-20 zener diode.

Remote Control Parts on UHF Power Supply Board	1 — 2N3393 transistor. 2 — 2N4121 transistors. 2 — 2N3859A transistors. 2 — 2N3416 transistors. 1 — 2N2712 transistor (used as diode). 1 — SN7472N integrated circuit. 1 — 1N191 diode.
Power Requirements	Transmitter: 100 milliwatts at 9 volts; supplied by a NEDA #1604* battery. Receiver: 3.4 watts (idling) at 120 Vac.
Color	Beige (transmitter case).
Meter	Tuning.
Transmitter Dimensions	4-3/4" x 3-1/4" x 1-3/8".
Net Weight	6-1/2 lbs.

*NEDA #1604 batteries include the following types: Burgess #2U6, Eveready #216, Mallory #MN1604, RCA #V5323, and Ray-O-Vac #1604.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.



BLOCK DIAGRAM

CIRCUIT DESCRIPTION

Refer to the Schematic diagram (fold-out from Page 81) and to the Block Diagram (Page 72) while reading this "Circuit Description." The part numbers on the Schematic diagram are arranged in the following groups to help you locate specific parts on the Schematic, chassis, and circuit board:

1-99 Parts in the transmitter

100-199 Parts in the receiver

The transmitter and receiver schematics are both included on the overall Schematic diagram along with a schematic representation of integrated circuit Q101.

TRANSMITTER

The transmitter is completely self-contained and operates from an internal 9-volt battery. Five control functions provide On-Off and Volume, UHF or VHF, Channel selection, Color adjustment, and Tint adjustment. The transmitter uses a basic Hartley oscillator circuit with a capacitor switching arrangement which selects a desired control frequency to drive a capacity-type transducer.

When a rocker switch is pressed, it performs two functions. The battery is connected through the switch contacts to ground, turning the transmitter on. At the same time, a capacitance is connected in parallel with the secondary winding of oscillator coil L1. This capacitance, plus the inductance of L1, determines the frequency of the oscillator (17 kHz through 22 kHz).

The oscillator frequency is doubled by the transducer and transmitted to the receiver.

Each rocker switch has its own capacitor, with C11 and C12 being common for all switch functions. The capacitance for the UHF-VHF function, for example, includes C3, C11, and C12. Note however, that the Channel Down function uses only the capacitance provided by C11 and C12. These two capacitors also form a voltage divider for the transducer that is effective for all switch functions.

R1 sets up the proper bias and C2 couples the proper feedback voltage to the base of Q8. C1 reduces the effects of the battery internal resistance, increasing the useful battery life.

RECEIVER

The receiver for your Remote Control unit is composed of the following sections: The integrated circuit amplifier, the detector and relay circuits, and the control circuits. Each of these sections will be described separately in the following pages. Briefly, these circuits work together in the following manner: The receiver microphone senses the transmitted signal and couples it to the integrated circuit for amplification. The signal is then amplified, clipped, and shaped to produce pulses at the output of the integrated circuit. The output pulses are then coupled to eight detector circuits, with each circuit controlling a relay. When a relay is activated and its contacts close, a control function (On-Off/Volume, Channel Up, etc.) occurs in the TV Set.

INTEGRATED CIRCUIT AMPLIFIER

The transmitter signal is received by the capacity-type microphone and coupled through C101 and R104 to pin 1 of integrated circuit Q101. C103, and C104, and R101 and R102 act as a filter and isolation for the microphone polarization voltage. The microphone polarization voltage will be described separately in a later paragraph.

Because of its high gain and to avoid unwanted feedback, the integrated circuit amplifier is carefully divided into three sections, which are coupled together with external capacitors. The sections are arranged as follows:

Section	Is Composed of	Output Terminal
one	Q101-1, Q101-2, Q101-3	3
two	Q101-4, -5, -6, -7	5
three	Q101-8, -9, -10	7

The input signal from pin 1 is first applied to Q101-1 and Q101-2, which are connected in a Darlington amplifier circuit to provide a high input impedance for the microphone. From Q101-2, the signal is coupled through emitter follower stage Q101-3 and coupling capacitor C105 to the second section. R103, R105, and C102 provide negative feedback at the lower frequencies so section one will have a high pass frequency characteristic. (The selectivity curve of this section is centered around 45 kHz.)

NOTE: All larger signals are limited in amplifier section one and again in amplifier section two. This results in a clipped sine wave at the input to section three. This limiting is necessary so the detector circuits are not overdriven.

In the second section, the signal is coupled through grounded emitter amplifier Q101-4 and emitter follower Q101-5. Q101-6 and Q101-7 are connected in an amplifier configuration to supply negative feedback to Q101-4 to maintain bias stability.

From Q101-5, the signal is coupled through C106 to grounded emitter output stage Q101-8. Q101-9 and Q101-10 are connected as a bias supply that is identical to the circuit of Q101-6 and Q101-7.

The collector of Q101-8 is connected to the primary winding of T101, which is tuned by stray capacitance (and the output capacitance of this transistor) to a resonant frequency of approximately 180 kHz. Each negative-going input waveform to Q101-8 cuts off this stage, allowing the primary of T101 to ring at its resonant frequency. The output signal that results is clipped by Q101-8, and a series of sharp positive pulses are coupled to the detector circuits. This series of pulses has a repetition rate equal to the frequency of the input signal.

Because of the limiting and nonlinearity of the amplifiers, the receiver is quite immune to random noises such as ringing bells, rattling keys, or jingling coins, which otherwise could trigger the receiver relays.

When a weak signal is received (for example if you were using the transmitter some distance from the TV Set), the first two sections of Q101 amplify the signal without any clipping or limiting. However, this weak signal is contaminated with noise generated by the circuitry. The weak signal modulates this noise in the third section, resulting in noise bursts which are at the same frequency as the input signal, and these modulated noise bursts drive Q101-8 into clipping. The noise bursts are fed to the proper detector circuit.

DETECTOR AND RELAY CIRCUITS

The output signal from T101 is coupled to eight detector circuits. Each circuit is tuned to one of the control signal frequencies as follows: On-Off and Volume – 42.5 kHz; UHF-VHF – 39 kHz; Channel Down – 44 kHz; Channel Up – 41.5 kHz; Color Down – 40 kHz; Color Up – 37.5 kHz; Tint Red – 34.25 kHz; and Tint Green – 36 kHz.

The eight detector transistors have a common emitter resistor, R112. When one transistor is conducting, the voltage drop across R112 increases. This increases the emitter voltage of the remaining transistors so they cannot conduct. A meter and current limiting resistor, R132, is also connected to the emitters of these transistors for the alignment of each detector circuit.

On-Off and Speaker

When a 42.5 kHz signal (positive pulses at a 42.5 kHz repetition rate) is present at T101, the signal is coupled through C111 to L101. These pulses cause L101, which is tuned to this frequency, to resonate at 42.5 kHz. The resulting sine wave is coupled through R109 to the base of Q102, causing it to conduct. Q102 draws collector current through the coil of relay RL101, closing the contacts. AC current then passes through these contacts and energizes the coil of stepping relay RL109.

The stepping relay performs three functions: it turns the TV Set on and off, controls the volume, and controls the polarization voltage for the microphone. The stepping relay contacts, which are operated by a cam, turn the TV Set on, keep it on for three more steps, and then turn it off again.

The TV Set is turned on by both sets of stepping relay contacts. Contacts 14 and 15 apply 120 Vac through lug 12 of the 15-pin connector to the filament transformer in the TV Set. Contacts 13 and 16 apply 120 Vac through lug 4 of the 15-pin connector to the power transformer in the TV Set. Contacts 13 and 16 also apply 120 Vac to the relay contact arms of the channel, color, and tint relays.

The cam in the stepping relay also turns the contacts on both sides of wafer switch SW101, which controls the volume from the speaker and the microphone polarization voltage. The polarity of this voltage is switched, from positive when the TV Set is on to negative when the TV Set is off, to prevent the microphone from losing its sensitivity over long periods of operation.

The following operating sequence of stepping relay RL109 will begin with the relay in the Off, or first, position. (See "On/Off," Page 57). In this position, the TV Set is off and a negative polarization voltage, which is supplied by diode D103, is coupled through lugs 6 and 4 of the switch and resistors R102 and R101 to the microphone. When the On-Off transmitter switch is pressed and released, the stepping relay will move to the next position.

In the second position of the relay, the TV Set is turned on and the negative voltage is removed from the microphone. In its place, a positive polarization voltage is supplied to the microphone by D104, through lugs 9 and 4 of the switch and R102 and R101. In this second position, the volume will be at the level set by the TV Set Volume control.

In the third position of the relay, the TV Set remains on and the positive polarization voltage is applied through lugs 12 and 4 to the microphone. The speaker sound is reduced by resistor R133, which is connected in parallel with the speaker by the other section of the wafer switch.

In the fourth position of the relay, the positive polarization is applied through lugs 7 and 4 to the microphone and the TV Set stays on, but the sound is further reduced by R134, which replaces R133 across the speaker.

In the next step the stepping relay contacts open, the TV Set is turned Off, the negative polarization voltage is switched back into the circuit, and the switch is again in the first position. This completes the stepping relay cycle.

Channel, Color, and Tint

When the transmitter Channel Down switch is **pressed and released,** a 44 kHz signal is coupled through the tuned circuit of C117 and L103 to the base of Q104. This causes the contacts of RL103 to close, and 120 Vac is applied through them and lug 3 of the 15-pin connector to one of the windings on the channel selector motor. The motor then turns and rotates the tuner "down" (counterclockwise) one channel. A set of cam-operated contacts on the motor are connected in parallel with the contacts of RL103. This allows the motor to receive power through the motor contacts as well as through the relay contacts.

When the transmitter Channel up switch is **pressed and released,** a 41.5 kHz signal is coupled through the tuned circuit of C122 and L104 to the base of Q105. This causes the contacts of RL104 to close, and 120 Vac is applied through them and lug 9 of the 15-pin connector to the other winding on the channel selector motor. The motor then turns and rotates the tuner "up" (clockwise) one channel. The cam-operated contacts are now connected in parallel with the contacts of RL104. The Tuner will continue to rotate as long as either switch is held down. When either switch is released, the cam-operated contacts will open and the tuner will stop on channel.

The Color and Tint control circuits operate the same as those previously described except for their different operating frequencies. Capacitor C127 provides the phase shift necessary for starting the color motor and resistor R129 protects C127 from voltage spikes. Capacitor C135 and resistor R131 perform the same function for the tint motor.

UHF-VHF Relay

When the transmitter UHF-VHF switch is pressed and released, a 39.0 kHz signal is coupled through the tuned circuit of C116 and L102 to the base of Q103. This causes the contacts of RL102 to close. This ground connection that results, made through the 15-pin connector (lug 8) and the remote control cable to the UHF-VHF switching circuit, grounds the emitter of input transistor Q903. (See "UHF-VHF Switching," below.)

POWER SUPPLY

When the master On-Off switch of the TV Set is turned on, line voltage is supplied to the remote power supply of the receiver, to one side of each motor winding, and to one side of the stepping relay coil. As the stepping relay is activated by the transmitter to the on position, the TV Set is turned on and line voltage is then available to complete the circuit for the Channel, Color, and Tint motors (through the individual relay contacts).

The power supply for the detector stages is contained in the Remote Control receiver and consists of transformer T102 and half-wave rectifier D102. The voltage from D102 is filtered by capacitor C113 and resistor R113. This resistor also provides the proper current for zener diode D101, which regulates the 20-volt output.

UHF-VHF SWITCHING

NOTE: Refer to the "UHF Power Supply Plug-In Assembly" section of the Schematic (fold-out from Page 81) while you read the following paragraphs. Note also, that the components contained in this schematic section are mounted on the UHF Power Supply Plug-In Assembly, which is part of the TV Set front panel assembly.

When the transmitter UHF/VHF switch is pressed and released, the emitter of Q903 is connected to ground through the remote control power cable and the contacts of relay RL102 in the receiver. This causes a negative-going pulse to be generated and applied to pin 12 of IC902, causing the IC to change state. For example, if pin 6 of the IC is at 0-volts and pin 8 at +5-volts, a negative-going pulse applied to pin 12 of the IC will cause pin 6 to go to +5-volts and pin 8 to go to 0-volts.

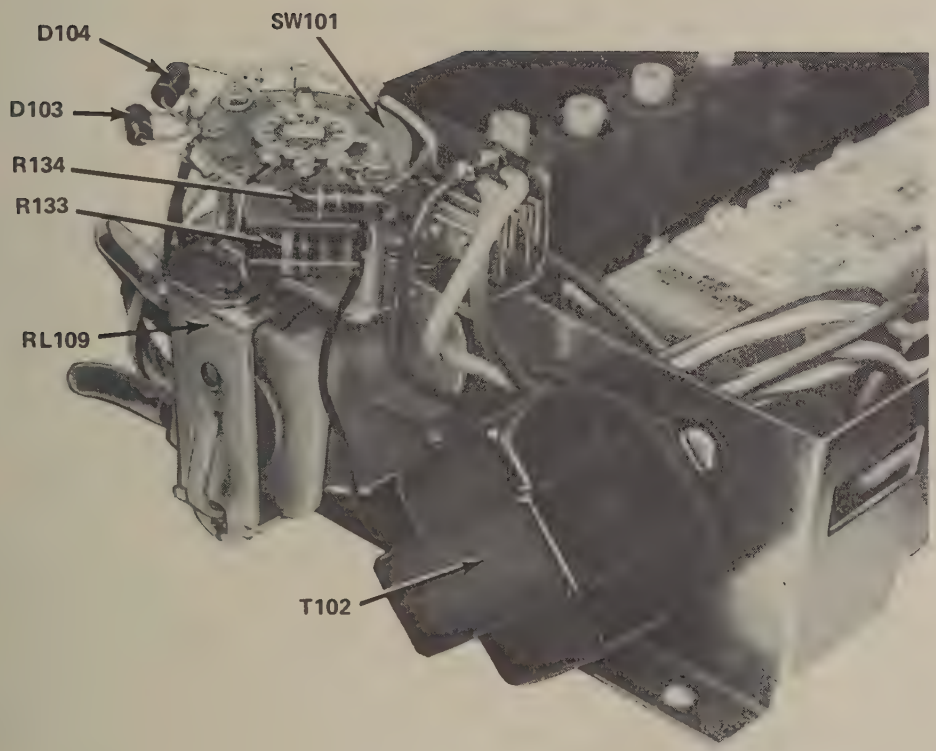
The +5-volts at pin 6 allows Q907 to turn on and saturate. Current flowing through R927 causes Q906 to turn on and saturate. The thirty volts now present at the collector of Q906 is applied to the UHF tuner through lug 9 of the 15-pin connector. Q909 will also turn on and saturate, turning on the UHF panel lamp through lug 6 of the 15-pin connector. Note that when Q906, Q907, and Q909 are turned on, Q904, Q905, and Q908 are turned off and the TV Set is operating in the UHF mode.

A negative-going pulse applied to pin 12 of the IC will change the state of the IC, causing pin 6 to go to 0-volts and pin 8 to +5-volts. This will cause Q906, Q907 and Q909 to turn off and Q904, Q905, and Q908 to turn on. The thirty volts is now applied through lug 15 of the 15-pin connector to the oscillator and rf stages in the VHF tuner, causing the TV Set to operate in the VHF mode.

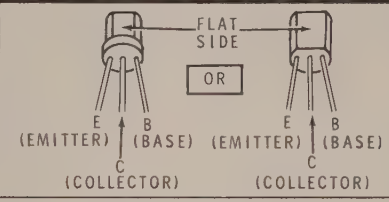
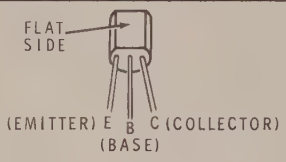
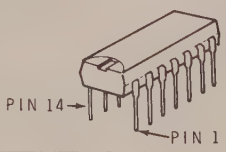
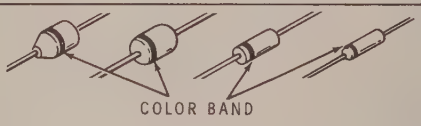
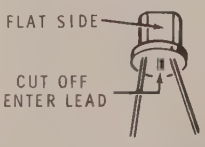
During normal operation +30V is supplied through R919, D902, and R918 to D903, Q903, and IC902. D903 is a transistor connected as voltage-limiting zener diode.

When the TV Set is turned off by the transmitter, voltage is still applied through R918 from the power supply in the Remote Control receiver. This will insure that when the TV Set is again turned on, it will still operate in the same mode (UHF or VHF) as when it was turned off. When the TV Set is turned off, the 26 to 32 volts from the TV Set circuitry is removed from the emitters of Q905 and Q906. D902 is now reverse biased by the +20 volts from the power supply in the Remote Control receiver, which is still turned on. This prevents the Remote Control unit from supplying voltage to the +30 volt line and the associated nonoperating circuitry in the TV Set.

IDENTIFICATION PHOTOGRAPH



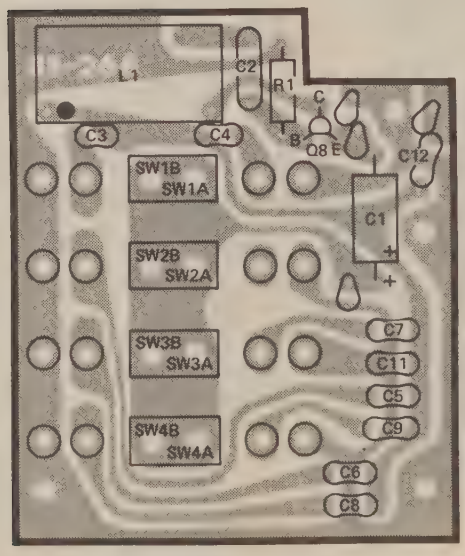
TRANSISTOR, INTEGRATED CIRCUIT, AND DIODE CROSS REFERENCE CHART

DESIGNATION	IDENTIFICATION	HEATH NUMBER	TYPE NUMBER
Q8, Q102, Q103, Q104, Q105, Q106, Q107, Q108, Q109, AND Q903 (TRANSISTORS)		417-118	2N3393
Q904, Q907 (TRANSISTORS)		417-135	2N3859A
Q908, Q909 (TRANSISTORS)		417-94	2N3416
Q905, Q906 (TRANSISTORS)		417-235	2N4121
Q101 (INTEGRATED CIRCUIT)		442-4	CA3035V1
IC902 (INTEGRATED CIRCUIT)		443-4	SN7472N
D101 (ZENER DIODE)		56-45	VR-20
D102, D103, D104 (SILICON DIODE)		57-27	1N2071
D902 (GERMANIUM DIODE		56-26	1N191
D903		417-77	2N2712

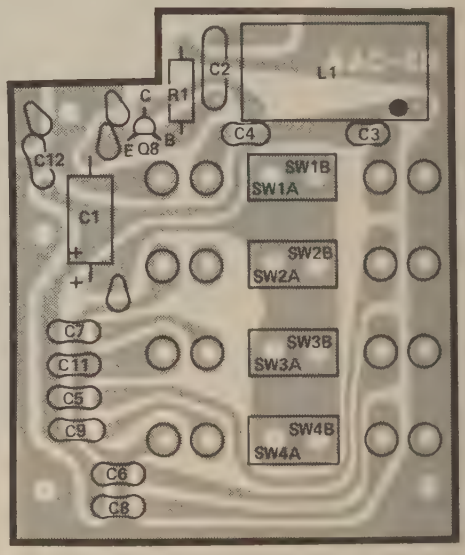
CIRCUIT BOARD X-RAY VIEWS

NOTE: To identify a part shown in one of these Views, so you can order a replacement, proceed as follows:

1. Note the identification number of the part (R-number, C-number, etc.).
2. Locate the same identification number (next to the part) on the Schematic. The "Description" of the part (22 kΩ, .05 μF, 2N2712) will also appear near the part.
3. Look up this Description in the Parts Lists.

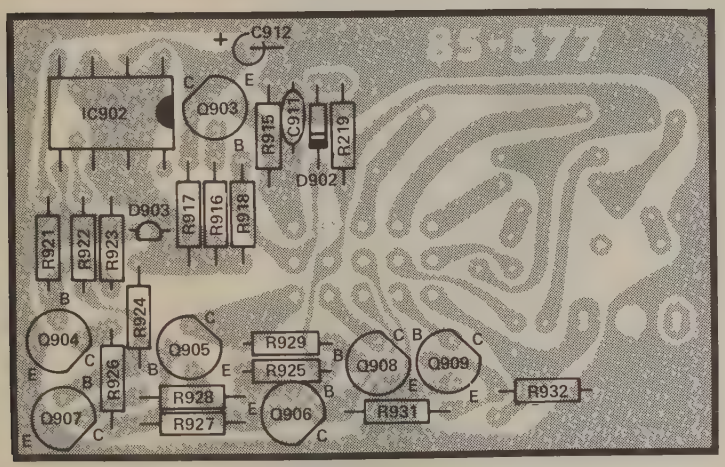


(Viewed from foil side)

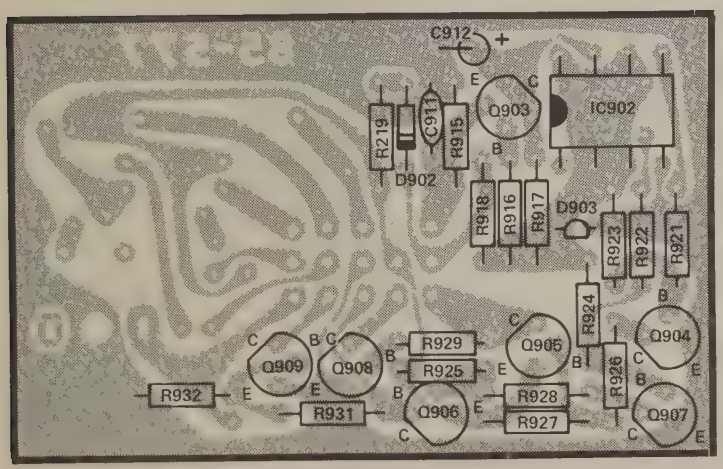


(Viewed from component side)

Transmitter

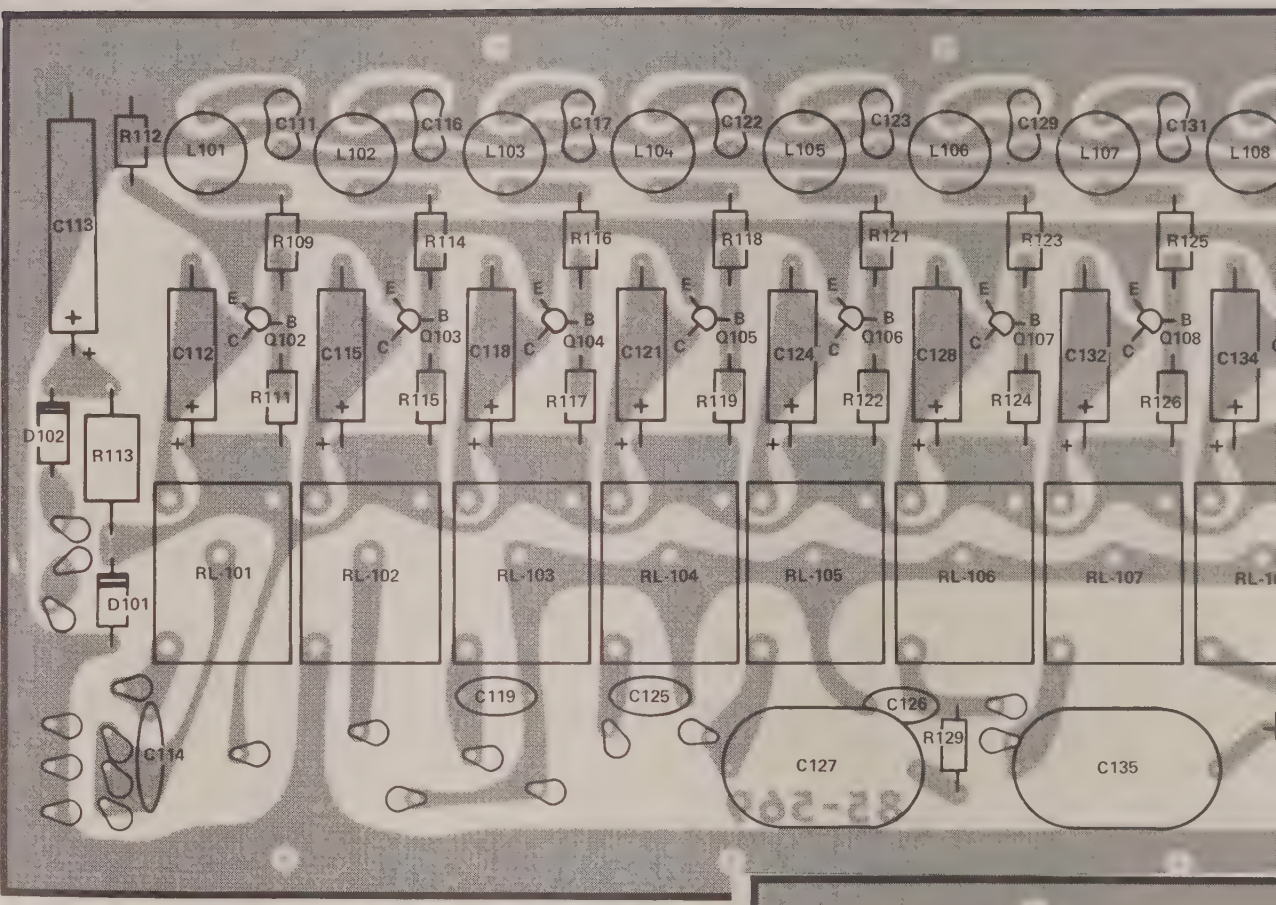


(Viewed from foil side)

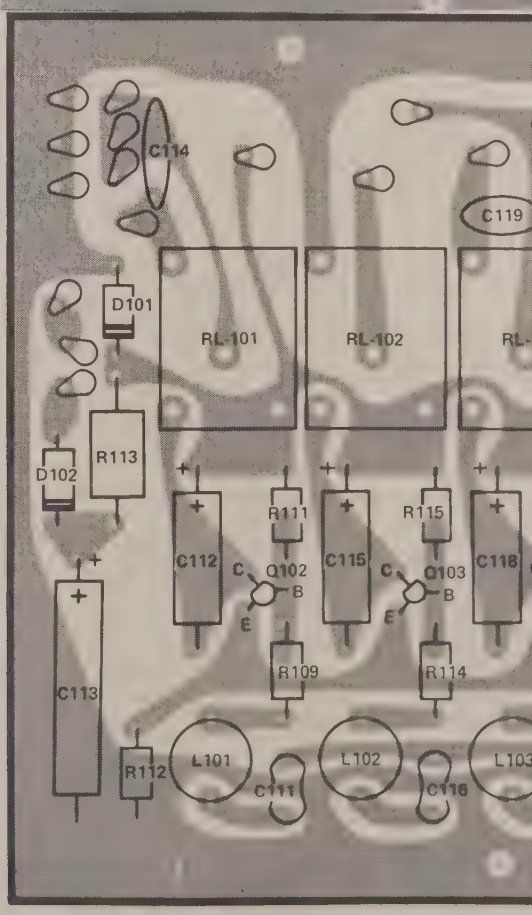


(Viewed from component side)

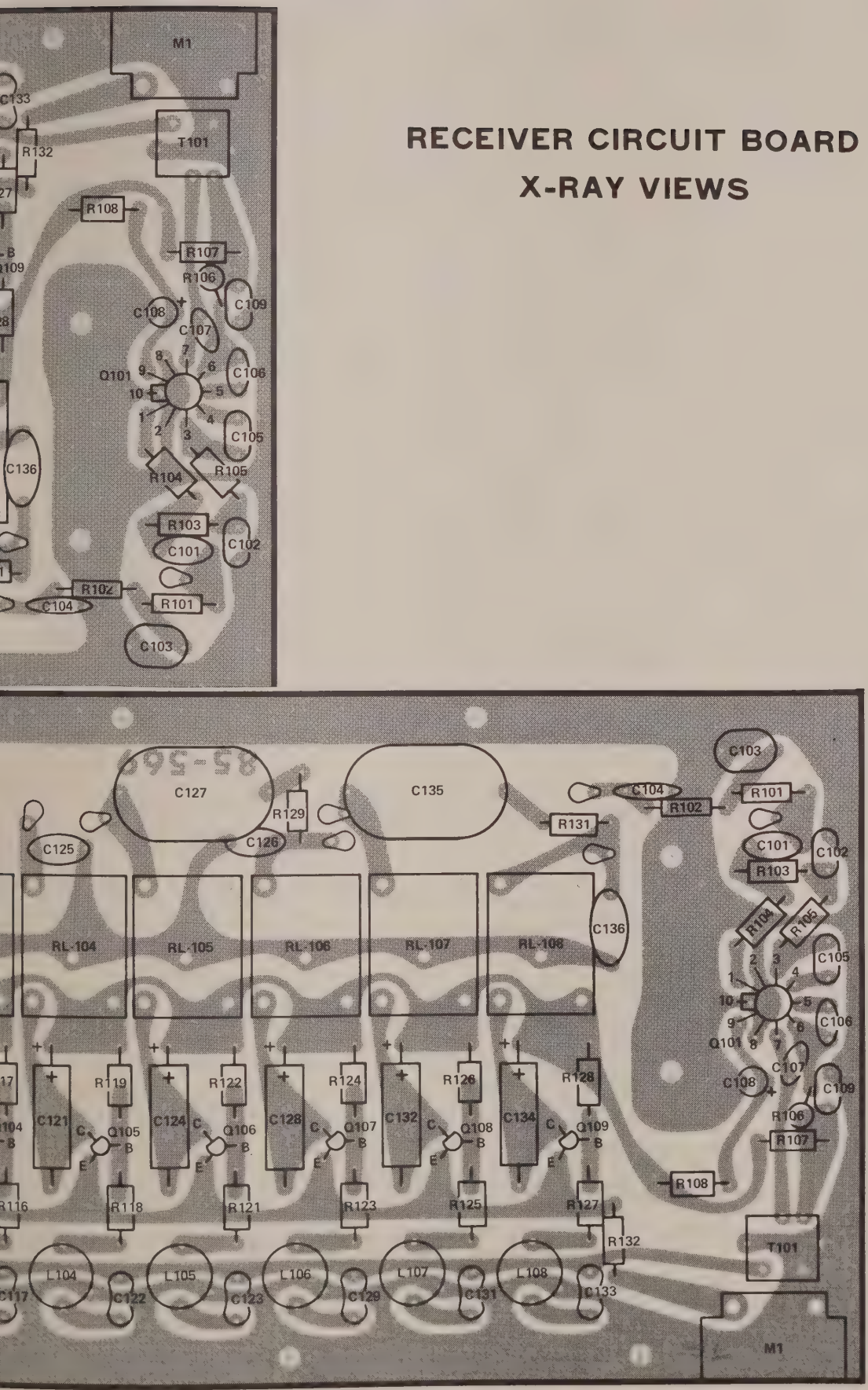
Remote Control Section of
UHF Power Supply



(Viewed from component side)

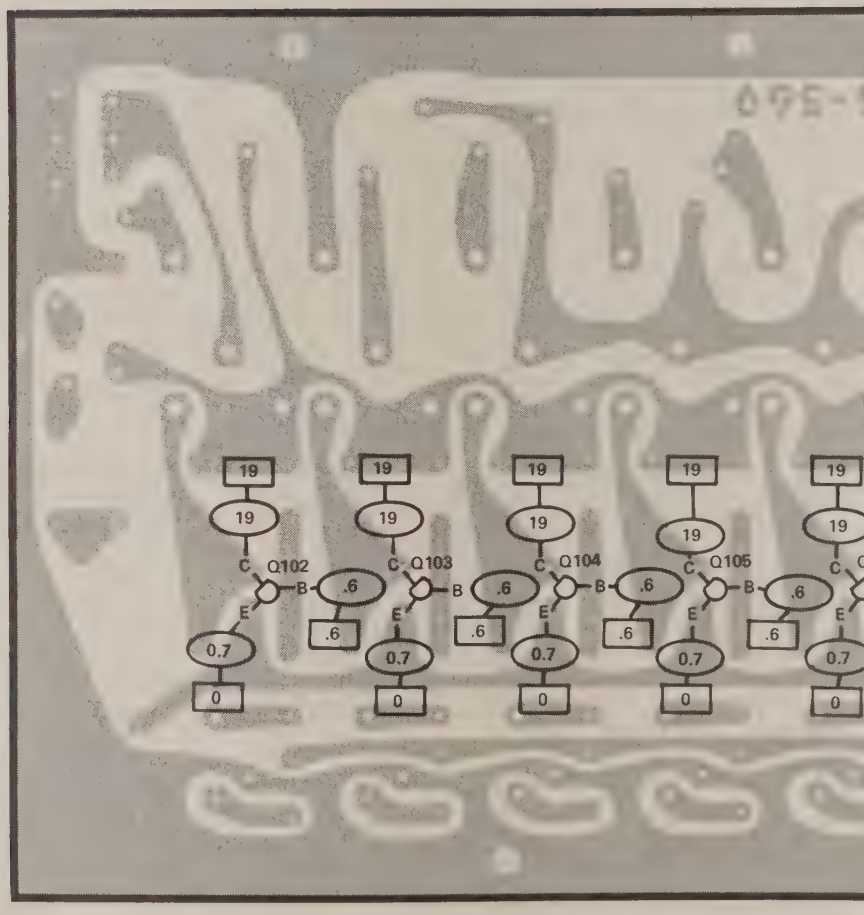


RECEIVER CIRCUIT BOARD X-RAY VIEWS



(Viewed from foil side)

RECEIVER CIRC

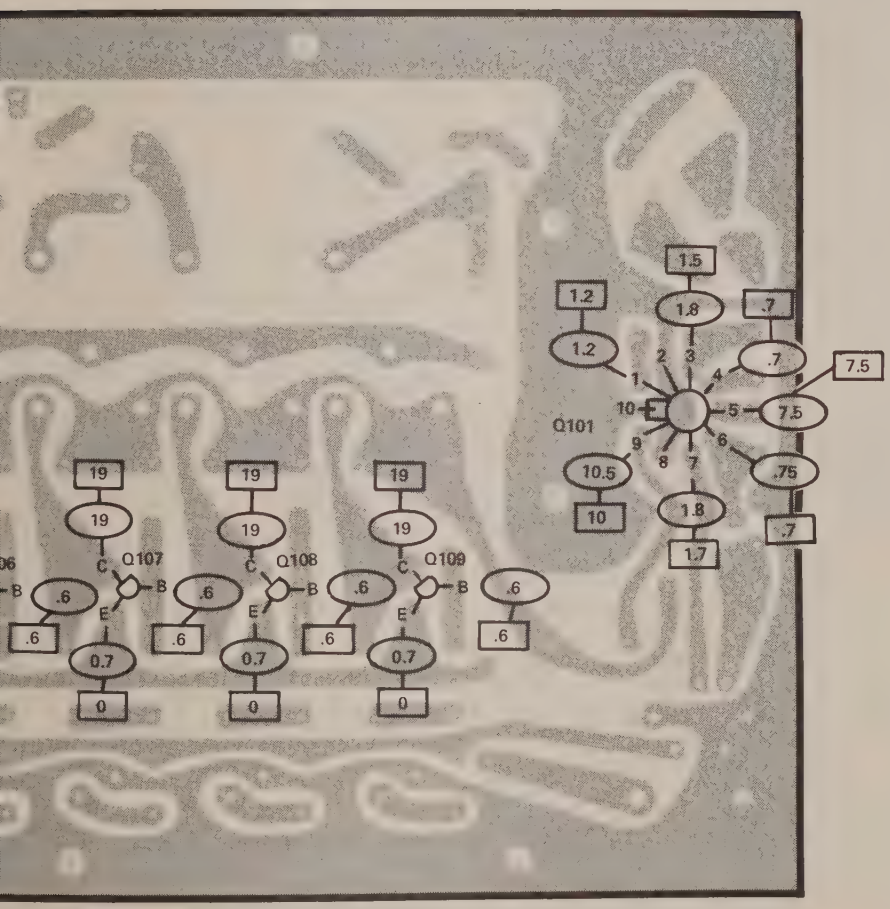


(Viewed

VOLTAGE MEASUREMENTS USING HIGH INPUT IMPEDANCE VOLTMETER.

VOLTAGE MEASUREMENTS USING THE "HEATHKIT TROUBLE SHOOTER".

UIT BOARD VOLTAGE CHART

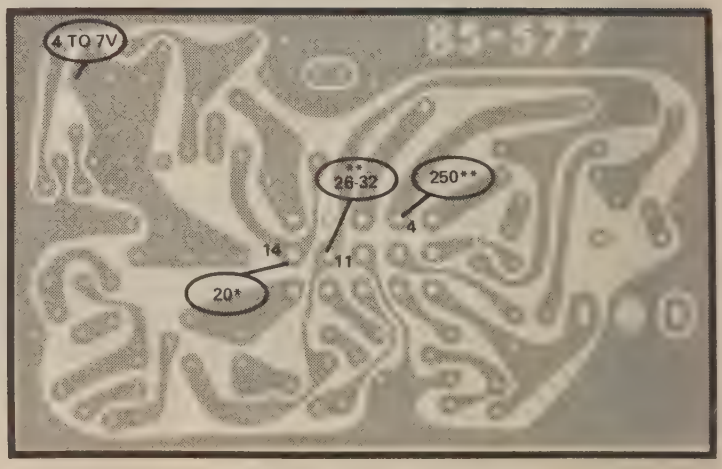


om foil side)

CIRCUIT BOARD VOLTAGE CHARTS

(Shown from foil side)

Transmitter Circuit Board



Remote Control Section
of UHF Power Supply Circuit Board

* FROM REMOTE RECEIVER.

** FROM TV SET.

SCHEMATIC OF THE HEATHKIT® REMOTE CONTROL MODEL GRA-900-6

NOTES

1. SCHEMATIC DESIGNATIONS FOR CIRCUIT COMPONENTS ARE IN THE FOLLOWING GROUPS:

1-99	TRANSMITTER COMPONENTS
101-199	RECEIVER COMPONENTS
901-999	UHF POWER SUPPLY COMPONENTS
200-299	THESE NUMBERS ARE ONLY USED AS REFERENCE NUMBERS FOR DESCRIBING THE OPERATION OF INTEGRATED CIRCUIT Q101. THEY DO NOT REFER TO ACTUAL CIRCUIT COMPONENTS.

2. RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS, (K=1000, M=1,000,000).

3. CAPACITOR VALUES LESS THAN 1 ARE IN µF. CAPACITOR VALUES 1 OR ABOVE ARE IN PF UNLESS MARKED OTHERWISE.

4. VOLTAGE MEASUREMENTS WERE MADE USING A HIGH INPUT IMPEDANCE VOLTMETER. VOLTAGES MAY VARY ±20%.

5. ⬭ THIS SYMBOL INDICATES A DC MEASUREMENT FROM THE POINT INDICATED TO CIRCUIT GROUND.

6 ▭ THIS SYMBOL INDICATES DC VOLTAGE IN THE UHF POWER SUPPLY IN THE UHF POSITION. REFER TO "UHF- VHF SWITCHING," PAGE 76.

7 ⬡ THIS SYMBOL INDICATES PRESENCE OF AC VOLTAGE.

8 ▽ THIS SYMBOL INDICATES CIRCUIT GROUND (COMMON FOIL) ON THE CIRCUIT BOARDS.

9 ⏚ THIS SYMBOL INDICATES CHASSIS GROUND.

10 ☐ LETTERS IN BOXES INDICATE WIRE LOCATIONS ON CIRCUIT BOARDS.

11 (*) THIS SYMBOL INDICATES THAT VOLTAGE ORIGINATES IN POWER SUPPLY IN RECEIVER OF REMOTE CONTROL.

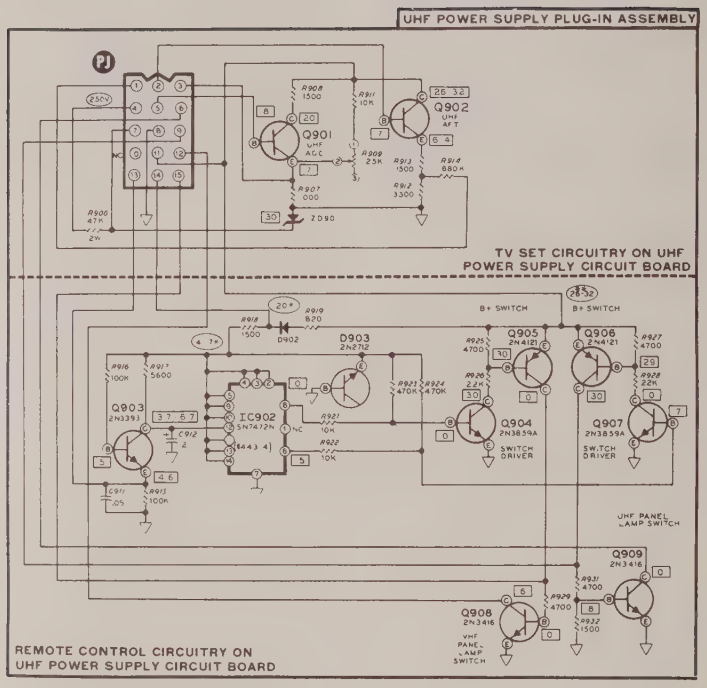
12 (**) THIS SYMBOL INDICATES THAT VOLTAGE ORIGINATES IN POWER SUPPLY IN TELEVISION SET.

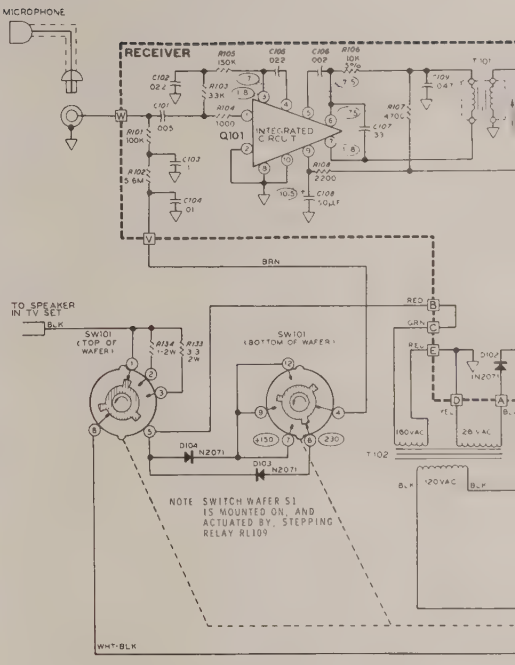
13 TRANSMITTER VOLTAGE CHECKS MADE WITH "CHANNEL DOWN" SWITCH PRESSED, AND COMMON LEAD OF VOLTMETER CONNECTED TO POSITIVE (+) TERMINAL OF BATTERY.

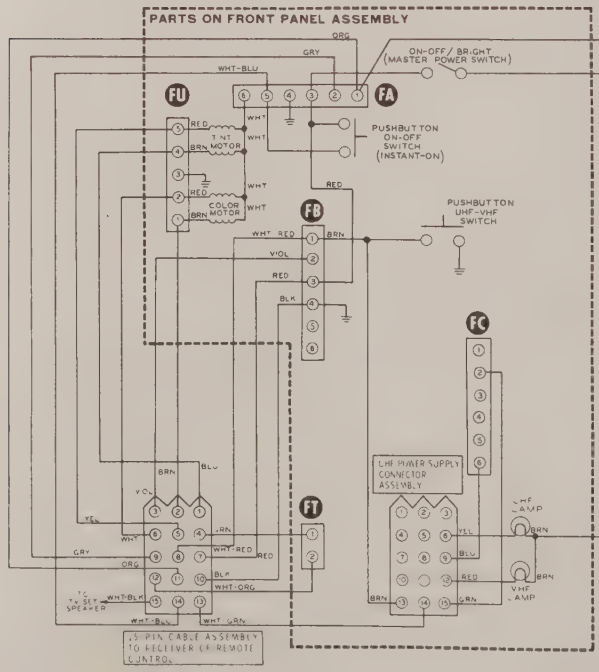
14 WAFER SWITCH ON STEPPING RELAY VIEWED FROM THE TOP, WITH CONTACTS IN POWER OFF POSITION. SWITCH ROTATES IN COUNTERCLOCKWISE DIRECTION WITH NO "STOP" POSITION.

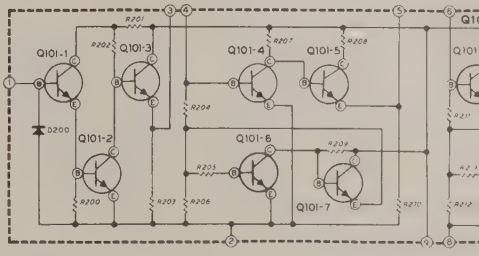
15 STEPPING RELAY CONTACTS ARE CAM-OPERATED. CONTACTS WILL BE CLOSED DURING ALL THREE VOLUME LEVEL POSITIONS OF SWITCH WAFER SW101.

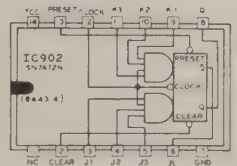
16 (FA) THIS SYMBOL INDICATES A TERMINAL STRIP ON THE FRONT PANEL ASSEMBLY OF THE TV SET.

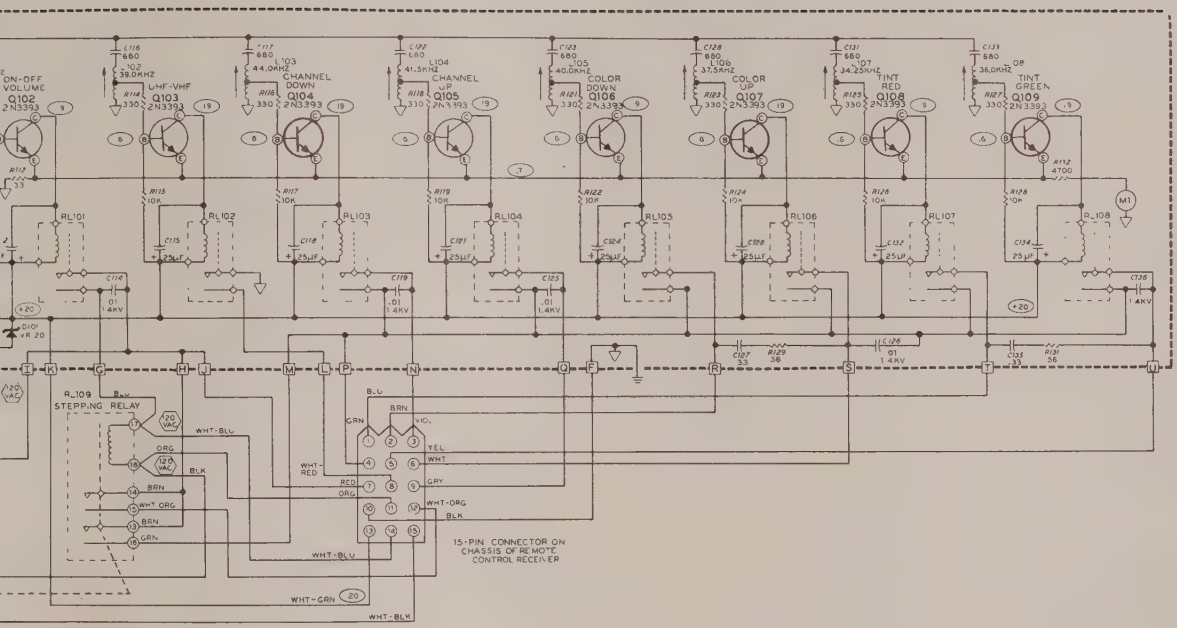

UHF POWER SUPPLY PLUG-IN ASSEMBLY
PJ
Q901
UHF AGC
Q902
UHF AFT
ZD90
TV SET CIRCUITRY ON UHF POWER SUPPLY CIRCUIT BOARD
B+ SWITCH
D902
D903
2N2712
Q903
2N3391
IC902
SN7472N
Q904
2N3859A
SWITCH DRIVER
Q905
2N4121
Q906
2N4121
Q907
2N3859A
SWITCH DRIVER
UHF PANEL LAMP SWITCH
Q909
2N3416
Q908
2N3416
VHF PANEL LAMP SWITCH
REMOTE CONTROL CIRCUITRY ON UHF POWER SUPPLY CIRCUIT BOARD

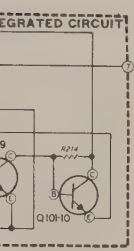

MICROPHONE
RECEIVER
INTEGRATED CIRCUIT
Q101
TO SPEAKER IN TV SET
SW101 (TOP OF WAFER)
SW101 (BOTTOM OF WAFER)
D104 N2071
D103 N2071
T102
120VAC
160VAC
28 VAC
NOTE SWITCH WAFER S1 IS MOUNTED ON, AND ACTUATED BY, STEPPING RELAY RL109
WHT-BLK

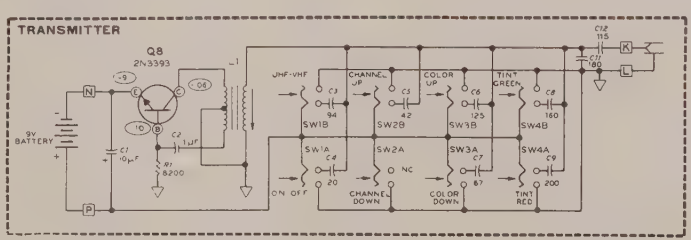

PARTS ON FRONT PANEL ASSEMBLY
ON-OFF/BRIGHT (MASTER POWER SWITCH)
TO AC POWER SOURCE
PUSHBUTTON ON-OFF SWITCH (INSTANT-ON)
PUSHBUTTON UHF-VHF SWITCH
TINT MOTOR
COLOR MOTOR
FU
FA
FB
FC
FT
UHF POWER SUPPLY CONNECTOR ASSEMBLY
WHT-BLK WIRE FROM 15-PIN REMOTE CONTROL CABLE
TO TV SET AUDIO OUTPUT
BLACK WIRE FROM REMOTE CONTROL RECEIVER
TO D751 (9.3VDC SOURCE)
VHF AMP
TO TV SET SPEAKER
15-PIN CABLE ASSEMBLY TO RECEIVER (R) REMOTE CONTROL


Q101-1
Q101-2
Q101-3
Q101-4
Q101-5
Q101-6
Q101-7
D200


IC902
SN7472N
PRESET
CLOCK
CLEAR
GND


ON-OFF VOLUME
Q102 2N3393
UHF-VHF
Q103 2N3393
CHANNEL DOWN
Q104 2N3393
CHANNEL UP
Q105 2N3393
COLOR DOWN
Q106 2N3393
COLOR UP
Q107 2N3393
TINT RED
Q108 2N3393
TINT GREEN
Q109 2N3393
RL101
RL102
RL103
RL104
RL105
RL106
RL107
R_108
M1
R_109 STEPPING RELAY
15-PIN CONNECTOR ON CHASSIS OF REMOTE CONTROL RECEIVER
WHT-BLU
WHT-GRN
WHT-BLK
BLK
ORG
BRN
GRN
RED
WHT-ORG
YEL
WHT
GRY
VIO.
BLU


EGRATED CIRCUIT
Q101-10


TRANSMITTER
Q8
2N3393
9V BATTERY
UHF-VHF
CHANNEL UP
COLOR UP
TINT GREEN
SW1B
SW2B
SW3B
SW4B
SW1A
SW2A
SW3A
SW4A
ON OFF
CHANNEL DOWN
COLOR DOWN
TINT RED

EXPEDITED PARTS ORDER FORM
(FOR REPAIR PARTS ONLY)

PLEASE DO NOT WRITE IN THIS SPACE

(1) Give Part Numbers as they are in parts list.

(2) Include remittance or permission for C.O.D. shipment. ☐ CASH ☐ C.O.D.

(3) Use separate sheet of paper for all correspondence.

(4) Prices may change to reflect current manufacturing costs.

(5) Current **HEATH** account number AA

KIT MODEL _____

DATE OF PURCHASE _____

SERIES NUMBER _____

QTY.	PART NUMBER	DESCRIPTION	PRICE	TOTAL PRICE	MARK PROPER SPACE FOR WARRANTY PARTS ONLY		
					3 DAMAGED	2 DEFECTIVE	1 MISSING

HEATH COMPANY
BENTON HARBOR
MICHIGAN 49022
PHONE 616-983-7381

NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____

THIS FORM IS FOR U.S. CUSTOMERS ONLY. OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR.

CUT ALONG DOTTED LINE

EXPEDITED PARTS ORDER FORM
(FOR REPAIR PARTS ONLY)

PLEASE DO NOT WRITE IN THIS SPACE

(1) Give Part Numbers as they are in parts list.

(2) Include remittance or permission for C.O.D. shipment. ☐ CASH ☐ C.O.D.

(3) Use separate sheet of paper for all correspondence.

(4) Prices may change to reflect current manufacturing costs.

(5) Current **HEATH** account number AA

KIT MODEL _____

DATE OF PURCHASE _____

SERIES NUMBER _____

QTY.	PART NUMBER	DESCRIPTION	PRICE	TOTAL PRICE	MARK PROPER SPACE FOR WARRANTY PARTS ONLY		
					3 DAMAGED	2 DEFECTIVE	1 MISSING

HEATH COMPANY
BENTON HARBOR
MICHIGAN 49022
PHONE 616-983-7381

NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____

THIS FORM IS FOR U.S. CUSTOMERS ONLY. OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR.

CUSTOMER SERVICE

REPLACEMENT PARTS

If you need a replacement part, please fill in the Parts Order Form that is furnished and mail it to the Heath Company. Or, if you write a letter, include the:

- **Part number** and **description** as shown in the **Parts List.**
- Model number and Series number from the blue and white label.
- Date of purchase.
- Nature of the defect.

Please do not return parts to the factory unless they are requested. Parts that are damaged through carelessness or misuse by the kit builder will not be replaced without cost, and will not be considered in warranty.

Parts are also available at the Heathkit Electronic Centers listed in your catalog. Be sure to provide the Heath part number. Bring in the original part when you request a warranty replacement from a Heathkit Electronic Center.

NOTE: Replacement parts are maintained specifically to repair Heathkit products. Parts sales for other reasons will be declined.

TECHNICAL CONSULTATION

Need help with your kit? . . . . Self-Service? . . . . Construction? . . . . Operation? . . . . Call or write for assistance. You'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek. . .please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit C.O.D. for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH

Schlumberger

MP MASTER

MA22763

HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.